Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

INFORMATION REPORT INFORMATI [redacted]

CENTRAL INTELLIGENCE AGENCY [redacted]

50X1

This material contains information affecting the National Defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C. Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

S-E-C-R-E-T [redacted]
NO FOREIGN DISSEM

COUNTRY	USSR	REPORT	[redacted]
SUBJECT	English Translation of Herald of Antiaircraft Defense, Issue No. 6, 1963	DATE DISTR.	24 February 1964
		NO. PAGES	[redacted]
		REFERENCES	[redacted]
DATE OF INFO.	[redacted]		
PLACE & DATE ACQ.	[redacted]		

50X1

50X1-HUM
50X1-HUM

[redacted]

1. An English translation of Issue No. 6, June 1963, of the Soviet publication Vestnik Protivovozdushnoy Oborony /Herald of Antiaircraft Defense/, published by the Military Publishing House of the Ministry of Defense, Moscow [redacted]

50X1-HUM

2. In some cases, the articles were translated in their entirety; in other cases, they were summarized. [redacted]

50X1-HUM

Distribution of Attachments for Retention:

[redacted]

50X1-HUM

OO/FDD:	1 copy
OSI:	2 copies
ORR:	2 copies
OCI:	1 copy
Air:	2 copies
FTD:	5 copies
SAC:	2 copies
Army:	3 copies
Army/FSTC:	3 copies
Navy:	2 copies
Navy/STIC:	1 copy
NSA:	2 copies

[redacted]

50X1-HUM

2

S-E-C-R-E-T
NO FOREIGN DISSEM

GROUP 1
Excluded from automatic downgrading and declassification

STATE	DIA	ARMY	NAVY	AIR	NSA	~~XX~~ NIC	OCR	
	Army/FSTC		Air/FTD	Navy/STIC		OO/FDD	SAC	

(Note: Field distribution indicated by "#".)

INFORMATION REPORT INFORMATION REPORT

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

S-E-C-R-E-T
No Foreign Dissem

50X1

Herald of Antiaircraft Defense
No 6, June 1963

S-E-C-R-E-T

No Foreign Dissem

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

S-E-C-R-E-T
No Foreign Dissem

Vestnik Protivovozdushnoy Oborony, No 6, June 1963

TABLE OF CONTENTS

S-E-C-R-E-T

No Foreign Dissem

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

In Chasti and Podrazdeleniya of Our Forces (Page 2)

Outstanding Specialist Becomes Master Operator -- by Maj I. N. LAVRUKHIN

Summary:

Reenlisted M/Sgt Valentin Fedorovich DEMCHENKO enjoys great authority among the personnel of a radar podrazdeleniye. He is a 1st Class operator and has been entrusted with training new recruits. DEMCHENKO has acquired several specialties, including those of a plotter and an electrician. He was one of the first men in the chast' to acquire the rating of "master operator," and he received much practical help from the officers of the podrazdeleniyq, particularly Engr-Lt BRYKOV. DEMCHENKO initiated a socialist competition among the personnel of his radar team for long-range detection of aerial targets and high precision in determining their coordinates.

[A photograph by N. OREKHOV shows Reenlisted M/Sgt V. DEMCHENKO speaking to his comrades about his work.]

Conquerors of the Yenisey River -- by Engr-Lt Col I. A. GARBUZOV

Abstract:

A short article describing a recent excursion to the construction site of the Krasnoyarsk Hydroelectric Power Station, which is to be the largest in the world. The excursion was reportedly organized by the Komsomol bureau of a training podrazdeleniye. GARBUZOV stated that the future officers inspected the construction work in Divnogorsk and even worked hand in hand with the builders. They were said to have returned to their school late in the evening.

Clubs for Curious and Resourceful Soldiers -- by V. A. VIKTOROV

Abstract:

Many chasti and podrazdeleniya of the Moscow PVO District are said to have organized clubs, on the initiative of Komsomol organizations, for curious and resourceful soldiers. Contests between soldiers are reportedly organized each Sunday for the greatest skill in the use of combat equipment and weapons, and the best knowledge of history and traditions of PVO Troops, as well as of works of literature and art.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

The Strengthening of Discipline is Our Daily Task -- Editorial (Pages 3-6)

Summary:

Following Lenin's teachings, the Communist Party is educating the Armed Forces in the spirit of strict discipline. The changes in the nature of armed struggle and the development of weapons of mass destruction have greatly increased the importance of discipline and other moral fighting qualities of soldiers. Each soldier must be ready and able to carry out his commander's orders at any cost whatsoever, regardless of any difficulties.

The soldiers' ideological convictions are the foundation of Soviet military discipline. Therefore, the state of discipline and order in the troops depends primarily on the political education of personnel. The chast' under the command of Col BESSOLITSYN is a good example; it has been awarded the transferable Red Banner for high results in combat readiness and in combat and political training. There are many such chasti and podrazdeleniya among PVO Strany Troops. However, in some podrazdeleniya the state of discipline does not fully meet present requirements. This can be explained primarily by inadequate ideological work. As is known, a relaxation in ideological education infallibly leads to a revival of vestiges of the past in the consciousness and behavior of individuals, to unethical actions, and to violations of service regulations.

It should be remembered that discipline, organization, and unquestioning obedience do not happen by themselves, but are developed and implanted in the course of military service.

The principal role in the strengthening of discipline belongs to one-man commanders. Only a demanding commander, who is able to coordinate measures of disciplinary influence with daily educational work, will be successful in establishing the proper order. However, some commanders try to ignore or even cover up breaches of discipline.

While a commander must be demanding to maintain firm military discipline, he must not be rude or insulting to the personal dignity of his subordinates. However, such instances still occur.

In order to strengthen military discipline, commanders must not only be more demanding toward their subordinates, but they must establish closer contact with the soldiers and improve organizational activities among the personnel. Some commanders still "stay aloof" from the soldiers and place deliberate emphasis on their superiority in rank. Such shortcomings in the work of commanders should not be tolerated.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

One should generally strive to increase the authority of sergeants who are the immediate superiors of soldiers, as this will tend to improve discipline.

Party and Komsomol organizations should give the commanders active support in the education of soldiers in the spirit of discipline.

The work of senior commanders, staffs, and political organs, should be improved. Not all senior chiefs take an active part in the propaganda of military requirements and regulations. Some commanders seldom speak to the soldiers and sergeants about the importance of discipline.

PARTY-POLITICAL WORK AND MILITARY EDUCATION

The Anniversary of the Great Party Should Be Celebrated in the Proper Manner -- by Maj Gen I. I. FROLOV (Pages 7-10)

Summary:

Soldiers of PVO Strany Troops are preparing to celebrate the 60th anniversary of the CPSU. In preparation for this great day, they are striving to gain new success in combat readiness and in the strengthening of discipline.

Lectures and reports are being given on the heroic progress of the Communist Party and its increasing role in the building of Communism. Officers RESHETNYAK and BELYAKOV gave interesting talks on the development of the party and the triumphant ideas of Marxism-Leninism. A group of lecturers, including officer NOGAL', gave a series of lectures on the role of the Communist Party and the Soviet government in strengthening Soviet defense power and developing the Soviet Armed Forces, particularly fighter aviation.

Film festivals devoted to Lenin and the Communist Party have been held in a number of garrisons. Agitators have developed intensive activities, their principal task being to explain party and government statements in connection with the 45th anniversary of the Soviet Army and Navy.

Party and Komsomol organizations have invited scientists, leading industrial and agricultural workers, and leading party officals to give lectures to military personnel.

Political activity among the personnel has increased and the best officers and soldiers are applying for membership in the party.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

The strengthening of ideological work is closely connected with organizational work aimed at improving combat training, increasing technical skills, and developing socialist competition in training and service.

Party and Komsomol committees and bureaus have done much organizational work in preparation for the anniversary. Pilots and technicians are competing for excellent ratings. Soldiers have taken socialist pledges stating that they will achieve complete interchangeability in their work. Rocketeers are striving to increase productivity in the preparation of rockets. Radar operators have pledged to detect targets at ranges considerably exceeding the tactical and technical data of radar stations.

The soldiers know that the party teaches them not to be satisfied with their achievements, but to continue perfecting their military and political knowledge and strengthening discipline.

[A captioned photograph by K. FEDULOV on page 10 shows Sr Lt Valentin Ivanovich GRIGORCHUK, commander of an outstanging podrazdeleniye, talking to his subordinates. GRIGORCHUK was elected party organization secretary.]

<u>Train Soldiers To Be On Their Guard</u> -- by Cols A. I. ZARUBIN and <u>A. P. KIRICHUK (Pages 11-14)</u>

Excerpts:

Reactionary circles of imperialist countries consider espionage very valuable in preparing for war against the Soviet Union and the socialist camp. For instance in the US, espionage has been raised to the rank of official government policy and millions of dollars are yearly assigned to it. Thousands of hired agents of the US employ any means or methods to find out military secrets which might, to some extent, give an idea of the combat capability and combat readiness of the Soviet Armed Forces.

The enemy is especially interested in information on the distribution, numerical strength, armament, combat training, and combat readiness of PVO Strany Troops; tactical and technical data on combat equipment; radar coverage; airfields; the location of fuels and lubricants, ammuntion, and rations; etc. Agents also attempt to find out data on the political attitudes and morale of personnel. Foreign intelligence services pay constant attention to our country's achievements in the realm of science and technology which strengthen the military and economic might of the USSR.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

To combat the insidious schemes of imperialist agents, the Soviet people use their revolutionary vigilance and their indefatigable watchfulness, which were willed by V. I. Lenin and are constantly taught by our Communist Party. The history of the Soviet state knows a multitude of examples wherein spying sabotage and other subversive activities of imperialist intelligence services and their agents inside our country were suppressed thanks to the high vigilance of our people.

Special watchfulness and constant vigilance are demanded of soldiers of the Soviet Armed Forces who must be on the alert to defend the peaceful labor of the Soviet people and the state interests of our country. Vigilance in military matters has always been of extreme importance. There is good reason for the saying: "Courage conquers cities, but vigilance protects them." However, the value of vigilance has never been higher than it is in our time. It is not by chance that the Program of the CPSU states that our Armed Forces, organs of state security, and all Soviet people should "manifest unremitting vigilance in relation to the aggressive schemes of the enemies of peace, guard peaceful labor, and be in constant readiness for the armed defense of their native land."

All of this [educational] work does not, of course, pass without a trace. It enables the vigilance of personnel to be increased and improves the performance of combat and guard duty. An example might serve to emphasize this.

Pvt NOVIKOV, while on leave in town, noticed an automobile full of civilians near a military installation. The soldier noticed that one passenger was photographing the installation. With the aid of passers-by, NOVIKOV detained the "amateur photographer" who was found to have taken pictures of combat equipment and various military installations. NOVIKOV was commended by his commander for his vigilance.

Many examples of skillful and thoughtful work in educating personnel in high vigilance could be cited. However, we would like to mention some shortcomings and omissions in this matter and discuss facts involving carelessness and thoughtlessness on the part of some serviceman. And such facts occur. Individual soldiers, sergeants, and even officers discuss the character of their work with their friends and families and, in doing so, disclose secret information. Wanting to show off how well informed they are on important secrets, they forget now and then that the information they divulge may fall into anyone's hands. For example, Pvt KAL'TSIN wrote in a letter to a girl-friend about the character of his combat work and about his own and his comrades' service duties. Then, he lost the letter.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

Other cases of dulled vigilance include rules being broken in carrying on telephone conversations, in handling secret documents, in discussing official matters in the presence of strangers etc. All of these violations are explained to a great extent by the fact that organizational and educational work of individual commanders, staffs, political organs, and of party and Komsomol organizations does not fully satisfy requirements. Sometimes, documents concerning questions of vigilance and observance of secrecy are studied and explained to personnel without any proper system, i.e., as the occasion demands. As a result, the rules contained in these documents are easily forgotten....

Communist VASYAKIN lost a document and it took the party organization 6 months "to react" to his error. And how? The problem concerning the tasks of Communists in increasing vigilance was discussed at a meeting and it was casually indicated to VASYAKIN that he should "pay attention to his lack of vigilance and his loss of a sense of responsibility for safeguarding official documents."...

It is very important that the historical decisions of the 22d Party Congress, the Party Program, questions of current policy, and requirements of allegiance oaths and regulations be explained, and that the felonious plans of imperialist aggressors and the crafty methods of enemy agents be disclosed to military personnel in political study groups, reports, lectures, discussions, and visual propaganda. All means of propaganda and agitation should be used to inculcate personnel with a feeling of hatred toward the bitter enemies of our native land and of the whole socialist camp....

Commanders, political organs, and party organizations should pay unremitting attention to command post crews and podrazdeleniya which are carrying on combat duty. The successful execution of any combat assignment depends to a great extent on the organization, discipline, and vigilance of personnel. It should also be kept in mind that great secrets are entrusted to command and duty post personnel, which are of special interest to foreign intelligence.

Educational work must be intensified in the case of personnel assigned to 24-hour details and to guard duty, and those who guard the entrances to chasti and military installations. Strict order should be established in our staffs, and the exact fulfillment of orders and instructions dealing with administrative matters should be achieved. The education of soldiers in the spirit of high revolutionary vigilance should constantly be in the center of attention of commanders, political organs, and party and Komsomol organizations. No matter how great the

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

successes of our native land in the building of Communism and in the international arena, they cannot be the basis for complacency and carelessness. The Communist Party demands that all educational work with troops, combat training, and the daily life of military personnel help to develop a sense of dupy and responsibility for the defense of our socialist country, unfailing vigilance, and constant combat readiness. "We must be vigilant everyday and every hour," remained N. S. KHRUSHCHEV, "Soldiers of peace, soldiers of the just cause, should always be ready to repel any aggressor, and to retaliate if enemies of peace should provoke an attack on our country or on any other country of the socialist camp."

Chronicle of Komsomol Life (Page 13)

Summary:

"Lenin and the Komsomol" was the topic of a recent meeting in a chast'. There were three generations of Komsomol and party members at the meeting, which was attended by several old Bolsheviks.

The commander and political section of a chast' have established a certificate (diploma) "for outstanding knowledge, servicing, and maintenance of combat equipment," to be awarded yearly to a section, group, or crew who are outstanding in combat and political training. To receive the award, all personnel of the involved unit must have been cross-trained in other specialties.

The Komsomol organization headed by Pvt MOSTOV took first place in the competition (smotr-konkurs) imeni Nikolay Ostrovskiy.

A group for studying the history of the Komsomol headed by Sr Lt KURCHANOV has been formed in a chast'.

Close contact has been established between a Komsomol organization where Pfc YERMOLOV is secretary, and a neighboring school. At the beginning of this year, soldiers organized a "Young Friends of the Soviet Army" detachment in the school. Here, the students study combat traditions of the Komsomol and the Soviet Armed Forces, and they are trained in special groups in the handling of firearms, radio and telephone equipment.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

The Role of the Party Organization in the Technical Training of Soldiers -- by Maj N. F. MAKAROV (Pages 15-17)

Summary:

Being well aware of the fact that combat readiness depends on the extent to which personnel of PVO troops have mastered their complex combat equipment, the party organization of a chast' considers the daily help to commanders in the technical training of soldiers as one of their principal tasks. To illustrate how the party organization handles this task, we will consider the example of the podrazdeleniye where Capt DEM'YANYUK is party bureau secretary.

At a party meeting to discuss the new training year, party members decided to take an active part in the development of good training facilities. Engr-Sr Lt RUDYUK and Lt BROSALIN were put in charge of this matter. With the podrazdeleniye commander, they prepared a plan for equipping classrooms and for preparing training aids. Their labors were successful, and when the training year began, the classrooms were well equipped.

Using the experience gained last year, the party bureau enlarged the scope of a technical study group to include the study of physics, mathematics, and radar. The group also has undertaken practical training in the correcting of equipment defects and in the servicing of equipment. The training is supervised by qualified engineers and technicians.

The party organization also aids the commander in organizing the training process by instructing sergeants in better training methods, by preparing technical literature, by aiding new personnel to become familiar with the equipment of the podrazdeleniye, and by aiding officers to perfect their training methods and to develop a proper sequence for training activities. The party bureau helped the commander to prepare and conduct a meeting for officer personnel on "The Responsibility of Officers for Organizing the Training Process." As a result of these measures, the quality of training has been significantly improved and training time is being used to its fullest possibilities.

A socialist competition was held to improve the mastery of combat equipment by all personnel. The progress of the competition was well publicized and the competition was successful.

Communist and Komsomol activistss aided in developing a sense of unity, comradeship, and responsibility among all personnel of the podrazdeleniye and urged everyone to help one another.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

The party organization took great care to organize technical propaganda and to make technical information available to all members of the podrazdeleniye. Special technical meetings were held and prepared by the party bureau for this purpose. This effort, like all the others, was crowned with success. The podrazdeleniye is becoming more and more proficient in technical training, knowledge, and skills.

(A captioned photograph by M/Sgt I. RYBIN, showing Lt Yu. POCHATKOV accepting a transferable pennant awarded to his platoon for success in combat and political training, appears on page 17).

A Restless Job -- by Capt A. M. BIRYUK (Pages 18-20)

Abstract:

Discusses how Sr Lt Ivan Mikhaylovich IVANOV, Radar crew commander (nachal'nik smeny) and secretary of radar podrazdeleniye party organization, trains his subordinates and is always ready to help in command problems and in servicing equipment. (A captioned photograph of Sr Lt I. IVANOV by P. GORDIYENKO appears on page 20).

COMBAT TRAINING

To Fly Without Accidents or Conditions Causing Accidents (Pages 21-26)

Abstract :

Maintains that it is possible to fly without accidents or incidents even during the most intensive training periods and discusses the means of achieving accident-free flight service. The primary cause of accidents is attributed to the lack of proper attention to discipline, organization, the observance of flight rules, and the failure to instill in pilots a feeling of responsibility for the fulfillment of service duties. Equipment inspection, flight critiques, and the physical health of aviators are emphasized as important factors in flight safety.

The Incident Could Have Been Prevented -- by Capt V. P. CHEKHOMOV (pages 22-23).

Abstract:

Discusses an incident which nearly led to an aircraft accident because of carelessness on the part of aviation specialists, the mechanic, and the technician and maintains that, in the interests of flight safety, it is the responsibility of each aviation specialist to check the work of his co-workers as well as his own work.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

A captioned photograph by K. FEDULOV on page 24 shows Capt V. SHALYGIN, Pilot 1st Class, after completion of an intercept mission. SHALYGIN intercepts target aircraft at the assigned intercept point and destroys it on the first attack.)

(A captioned photograph by P. GORDIYENKO on page 26 shows Capt O. PANASENKO, Pilot 2d Class, in the cockpit of his aircraft prior to takeoff.)

Ground Training Must Be Improved -- by Capt O. I. YERIN, Pilot 1st Class (Pages 27-29)

Abstract:

Discusses the need for improvements in ground training programs due to the increased demands for technically well trained pilots. Because the modern pilot is well trained in theoretical subjects and needs little additional training in that area, practical training on equipment and training devices should be stressed as an important means of perfecting the combat mastery of PVO pilots.

(A captioned photograph by I. RYBIN on page 28 shows Capt R. KARABANOV who recently passed an examination for the title of pilot 1st class. All the pilots in the chast' where KARABANOV serves are preparing to take the examination for pilot 1st class before the year is out.)

Working With Equipment Quickly and Skillfully -- by Engr-Col Ya. I. FAYENOV (Pages 30-31)

Excerpts:

The process of transferring equipment from the traveling to combat position, as is known, requires much work. To execute these operations as required within an established time, personnel must know their functional responsibilities to perfection, have firm work habits, and be firmly guided by proper instructions and directions.

Unfortunately, this is forgotten in some podrazdeleniya. Many necessary directions were not followed in one rocket podrazdeniye when they were trained in setting up equipment. A superior commander had to interfere to correct the mistakes which had been made.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

[redacted]

50X1

The soldiers acted uncertainly and without spirit while setting up cabins in this training activity, because they were not sure of their functional responsibilities. The officers did not give commands during the operation and accordingly their subordinates did not report on the completion of each stage of the operation. Also, required instructions were not followed in laying cables. Certain officers did not check the correctness and reliability of the cable connections to the cabin input box. All of this led to the deployment operation requiring more time than was required.

One cannot put up with this sort of shortcoming in combat training. A future nuclear rocket war, if the imperialists unleash it, will be characterized by constantly changing and highly maneuverable combat operations involving sudden, powerful strikes both against troops and deep rear areas of the combatants. Maneuverability acquires an extremely great importance in such conditions. Personnel must be well trained in changing positions and in preparing equipment for combat in any ground or aerial situations. All of this is learned in peacetime during training, tactical exercises, study, marches, etc. All of this combat training is of great value only when it is executed in conditions which closely approximate actual combat without simplifications.

It is very important that rocket podrazdeleniya change positions, execute march movements, and learn to transfer equipment from travel to combat positions in the shortest possible time during tactical training activity. Such requirements are self-evident since the smallest delay in arriving in a designated region, or slowness in setting up and preparing equipment for combat, inevitably leads to a situation where an enemy may succeed in destroying a protected objective.

The experience of leading podrazdeleniya shows that when officers pay close attention to such factors of combat training as setting up and removing equipment, personnel know their functional responsibilities well and are properly trained in preparing equipment for combat. The most notable successes are achieved by those commanders who constructively approach the training of subordinates in working with equipment and in shortening the time required for operations, and who develop courage, initiative, and physical endurance in their personnel.

Remembering that modern rocket equipment does not tolerate superficial knowledge of its construction and operation, or unskilled and ignorant manipulation, the commanders of leading podrazdeleniya carefully organize the training of subordinates to instruct them in their functional responsibilities in setting up equipment, making the most effective use

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

of each minute of training time. It is their goal to have crew members receive sufficient practice in setting up equipment for combat and in preparing it for travel, to eliminate mistakes which may lead to equipment damage or to personal injury to see that rules for equipment safety are strictly observed and that personnel learn to fulfill their responsibilities in night conditions and with the use of antichemical defense equipment.

The most labor-consuming operation in setting up and removing equipment is the assembly and disassembly of station antenna arrays. Therefore, in order to shorten the norms for executing this operation, rocketeers search carefully for the best method of distributing responsibilities among crew members when removing and setting up antenna equipment. Certain podrazdeleniya have been successful in these efforts. Some crews use four additional soldiers above their normal complement to set up antenna systems. To facilitate the operation, these crews fasten handles to the ends of wooden bedding. This helps to reduce the time in preparing a station for combat.

In order to shorten norms for setting up and removing equipment, the method of placing antennas on vehicles has been changed and many adaptions have been made. In some podrazdeleniya, the antenna is placed on a vehicle with the help of a titling device directly from a vertical position, instead of being first lowered to the ground.

Earlier, there had been instances when an antenna upset a crane during the dismantling process. To avoid this, rigid supports are now placed under the crane jacks before the operation.

The rapid and skillful work of crane operators is of great importance in shortening norms for setting up and removing equipment. It is recommended that these specialists be trained with model antennas to develop their skills.

Rolling up cable equipment is done in a different manner. Nowadays cable is not wound on drums, but on coils. The reverse travel jack of a launcher is used to remove wedges from hard ground. This saves much time.

The choice of terrain for setting up equipment is of great importance for operation success. The selected launch position must not only be suitable for proper placement of equipment, but it must fully meet the most important condition of enabling fire to be directed against an aerial enemy in any direction. Therefore, commanders must inculcate subordinates during training with the skills of determining the elements of combat procedure, the center of the launch position, the principal launch direction, the location of shelter areas, the means of locomotion, etc....

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Methods for Training Operators -- by Lt Col Ye. A. SHEVCHENKO and Capt D. A. PANTYUKHOV (Pages 32-34) 50X1

Abstract:

Emphasizes the importance of careful selection and training of radar operators and presents a model instruction plan to be used in their training and model graphs and formulas for use in training evaluation.

Conducting Tactical Training -- by Col V. I. AKULOV and Engr-Col E. A. LERNER (Pages 35-38)

Text:

The requirements for combat readiness and training of radio-technical troops personnel are increased each year. This is caused by the development of the means of aerial attack on one hand and of radar equipment on the other. Today, when an aerial situation in combat is so very complex, command post crews and primarily their officers have a particular responsibility. This creates the necessity for perfecting methods of officer training and for raising their professional skill in every possible way.

Each combat crew officer must master the necessary knowledge and skills to enable him to utilize the capabilities of various radar equipment, to quickly and correctly process the huge flow of information which arrives from podrazdeleniya, and to reproduce it precisely on plotting boards. He must also know how to resolve suddenly arising tactical problems quickly and correctly, to "read" an aerial situation without error, to draw the necessary conclusions from it, and boldly to make necessary decisions.

An officer must possess a sufficiently developed tactical thinking process, including the ability to analyze and evaluate an aerial situation, to foresee the sequential development of events, to quickly react to a change in a situation, and to make necessary corrections of an earlier decision. Finally, a command post officer must have such qualities as visual memory, keenness of observation, speed of reaction, etc.

This is why, in our opinion, it is necessary to reject the incorrect opinion that an officer having service experience in any specialty can work in a command post crew. A certain amount of service experience is, of course, a necessary condition for the formation of an officer's

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

tactical thinking process. However, this is not enough. The present work of a command post officer is a new and complex specialty which can only be mastered by a specialized, thoroughly thought-out, and purposeful program. Which do we consider as the basic attitudes and methods underlying this training.

The question of theoretical knowledge, and mainly knowledge in the realm of tactics,,was discussed in sufficient detail in the article, "Tactical Training of Radiotechnical Troops Officers," by Engr-Col Ye. I. GORBACH, published in Vestnik Protivovozhdushnoy Oborony, No 2 1963. Therefore, we will dwell only on those questions which reflect the specific character of a command post officer's work and his concrete functional responsibilities. Thus, for example, present programs for training command post officers in the material parts of radar equipment sometimes differ little from programs and methods intended for specialists of other categories (engineers, technicians, etc.).

Is it necessary for command post officers to study the line diagrams and tuning of all types of radar and radio sets? When they study equipment, it is obviously necessary that great attention be paid to thorough study of the combat capabilities of radar in various aerial situations and that the study should not be limited to a formal study of the tactical and technical set data which is included in factory descriptions. Undoubtedly, officers must thoroughly know the block circuits of all types of radar sets in order to be able to clearly understand what will be the effect on the combat readiness of the set if a block should go out of order.

Thorough and purposeful theoretical training is only one of the basic requirements for command post officers. Another necessary condition is the development of the whole complex of practical skills connected with the performance of functional responsibilities of a combat crew.

Presently, the most wide-spread and sometimes the only aspect of practical training for officers is training conducted at command posts. In our opinion, it is time to consider how to perfect methods for cultivating necessary practical skills among officers. With all the advantages of training whole or partial command post crews, this at times is of little use to officers, especially in the development of their tactical thinking habits. Usually training in basic activity is of use to soldiers and sergeants who perfect their skills in representing situations on plotting boards, in completing computations, and in transmitting reports. Thus it happens that sometimes a crew "chases" targets over a plotting board for several hours, but the officer personnel do nothing at all. Therefore, training periods conducted with complete crews for the elaboration of duties, we believe, should be carried on during the concluding stage of working out a

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

problem. Such training knits a crew into a whole and ties its various functional parts together.

A series of practical training periods for officers conducted by a method requiring practice and using training slides should certainly precede the type of training discussed above. These training slides, as is known, present a choice of various tactical problems. They are subdivided into several aspects according to the purposes of the training.

The purpose of the first aspect is to consolidate achieved theoretical knowledge among the officers, to develop their skills in the practical use of this knowledge in combat operations, and to study the correct method of resolving tactical problems which arise in a concrete situation. The method of carrying out the training with the use of slides consists of the following. The training is carried out by a group exercise method. The supervisor shows the group a sequence of slides which graphically portrays an appropriate problem and poses questions. A determined amount of time is allotted for solving the problem depending on the complexity of the problem and this time period is shortened according to the amount of practical skill which the trainees have accumulated. Each officer solves the problem independently. Then the supervisor calls upon several people, listens to the various solutions, reviews their analyses, and draws a conclusion.

The second aspect of training with slides is intended to give command post officers the necessary practical skills to analyze and make a generalization of an aerial situation rapidly and correctly. The trainees should learn "to read" an aerial situation which is portrayed graphically on plotting boards, to select all useful information from it, to find what is important, to know how to quickly draw conclusions concerning this situation, and to report them clearly, briefly, and at the same time accurately.

The slides for this aspect are arranged in sequential sets for a graphic portrayal of a concrete aerial situation as shown on plotting boards. The trainees should study it for a determined time and then make reports concerning it. In order to develop correct methods of situation analysis and a precise command language among the officers in the first stages of training, the reporting can be carried out without the plotting board portrayal being removed. Later, the situation reporting should be done from memory and the sequential

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

portrayal shown only for a determined amount of time and then removed. The time for the depictions is constantly decreased depending upon the complexity of the situation shown and the number of moving targets involved until it is reduced to from 10 to 30 seconds. The complexity of the situation should be correspondingly increased and it should include new elements and variants (interference, pilotless means of aerial attack, etc.).

To introduce variants in the training conducted with the second aspect of training with slides, the following method can be put into practice.

The students are shown an aerial situation with an error allowed in the situation representation, such as an incorrect target plot or mistakes in target enumeration, etc. They must quickly find this mistake and make a correct decision. It should be said here that command post officers often have to handle such situations in the course of actual combat operations. It is expedient to carry on such training on a daily basis.

The preparation of slides with tactical problems is not difficult. Therefore it is best to prepare them locally in each separate command post so that officers can solve problems of a determined type in the actual condition of their own operations. Slides which are issued centrally should be done in color. This enables the best visual representation of a situation. Finally in order to develop among personnel a common method of resolving problems for all basic questions of combat operations, a collection of problems with detailed resolution and analysis of each should be prepared in addition to the slides.

Training slides, as far as possible, should embrace the whole variety of tactical problems with which command post officers come in contact during actual combat operations. The experience of study and training carried on with an actually designated "enemy" should be widely used for this purpose and the most interesting and instructive situations and variants of an aerial situation should be selected from this experience. On the other hand, those elements of an aerial situation which are difficult to reproduce such as the actions of ballistic rockets, air-to-ground rockets, etc. should be reproduced on the slides.

Naturally, it is not possible to consider a large number of assignment problems in one article. We will consider only a few of them for training with slides of the first aspect.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

1. As is known, in the detection zones of all types of radars, there is a "dead cone." With flights at high altitudes it is necessary to take into consideration the possibility of a gap in target tracking when they enter into this "cone." Command post officers must be able to quickly determine the size of the target tracking gap for separate podrazdeleniya and give the proper commands for high altitude target reconnaissance. The size of such a gap depends upon the radius of the "dead cone" of a given type of radar at a given target altitude and course in relation to the radar. If the target has a radial course in relation to the radar, the gap in target tracking will be equal to the diameter of the "cone" and with an oblique course (Fig 1), it can be determined by the following formula:

$$L_{pr} = 2\sqrt{R_{mv}^2 - r^2}, \qquad (1)$$

where L_{pr} is the size of the gap in target tracking inside of the "dead cone" in kilometers;

R_{mv} is the radius of the "dead cone" in kilometers;

r is the distance to the target on the course parameter.

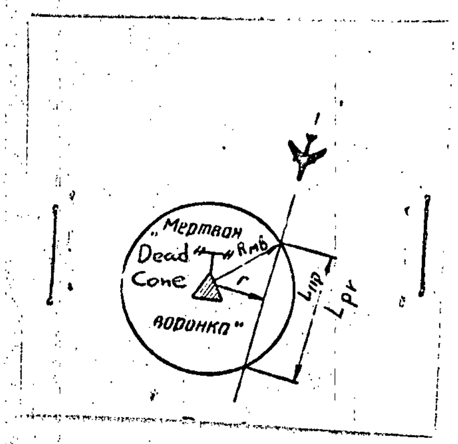


Fig 1

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

At first glance, this method might seem cumbersome, requiring too much time for calculation. But it is not necessary to carry out the calculation each time. Suitable tables can be computed and completed earlier. Incidentally, it should be noted that there has long been a need for special computers for officers of the Radiotechnical Troops [RTV] (similar to navigation computers), to enable speedy calculations.

To cultivate the skill of solving similar problems, a series of assignment problems on this theme should be worked out. Here we would like to draw attention to the following question. For some reason it is believed that the measuring of distances on a plotting board can only be done by using a compass and rule for direct measurement. This requires much time and such measurements can not always be done on large vertical plotting boards. At the same time, all plotting boards have distance standards or quadrant grids which have definite dimensions. An officer should know how to determine a distance on such a standard quickly and precisely without having to use any measuring equipment. This is entirely possible. A radar operator solves a similar problem by visually counting off a distance with a precision of up to 0.5 kilometers.

Of course, a command post must have measuring equipment, but in our opinion it should be used primarily for checking.

2. In problems involving the supplying of radar information for the combat activity of air defense rocket troops [ZRV] and fighter aviation [IA], attempts must be made to supply the information from only one radar station, since precision is decreased when information is supplied from different radar stations. Therefore, command post officers must often determine in which radar detection zone a target will be located for the longest uninterrupted time period. This question is also urgent for high-altitude targets.

As is known, a high-altitude target with a course tangent to the "dead cone" of a radar station will be in a radar detection zone for the longest time. But this is an ideal situation. For this reason, in order to track targets a radar station must be designated where the target course does not go through the "dead cone." The problem is solved in a manner analogous to the last solution (Figure 2):

$$L = 2\sqrt{D_{obn}^2 - r^2}, \qquad (2)$$

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

where L is the length of the course during constant observation of target in kilometers; 50X1

D_{obn} is the distance for target detection in kilometers;

r is the distance to the target on the course parameter.

The time required for calculation can again be shortened by using tables or special computers.

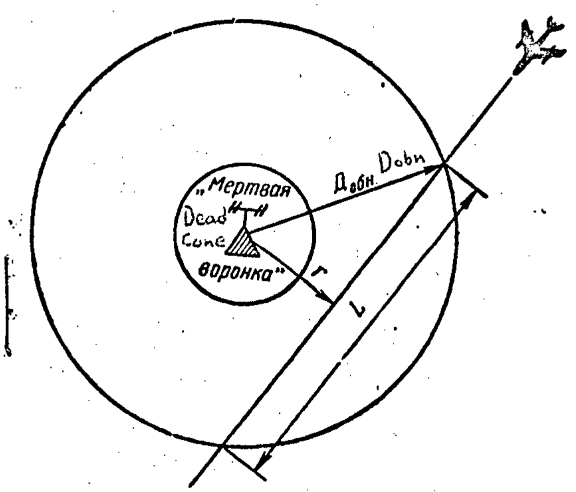


Fig 2

3. Let us consider still another example which shows that in the evaluation of reports concerning target composition a command post crew officer must be well acquainted with the capabilities of radar stations and with the causes of decreases in their capabilities for determining target composition. It is evident from figure 3 that the target is observed by two radar stations of the same type. Apparently the conditions for determining target composition are the same, as both stations can use distance resolving capabilities, yet the data concerning target composition are different.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

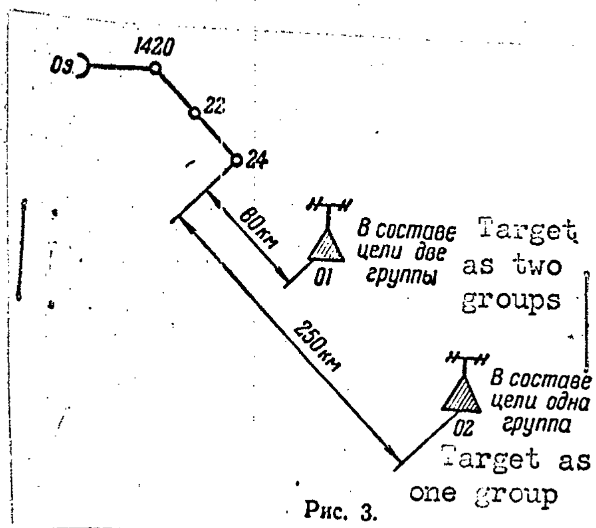


Рис. 3.

Fig 3.

The distance-resolving capabilities of the radar stations are the same:

$$\Delta D_{km} = 1.25\frac{st}{2} + 1.3\frac{D_m}{l_{shk}} D_p, \qquad (3)$$

where ΔD_{km} is the distance-resolving capability in kilometers;

s is the propagation speed of electromagnetic energy (3.10^5 kilometers per second);

t is impulse duration per second;

D_m is the indicator scale;

l_{shk} is the scan length in millimeters;

D_p is the indicator spot diameter in millimeters.

It is evident from this expression that distance-resolution capability depends to a significant degree upon the rating of the indicator scale. It is most likely that the difference in target composition is caused by the operation being done with different scales. It is evident that radar station 01 had a 100 kilometer scale and that radar station 02

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

had a 400 kilometer scale. We shall determine how this is reflected in the resolving capability (we assume that t = 5 microseconds for both stations). For radar station 01:

$$\Delta D_{km} = 1.25 \frac{3 \cdot 10^5}{2 \cdot 2 \cdot 10^5} + 1.3 \frac{100 \cdot 1}{160} = 0.94 + 0.81 =$$

$$= 1.75 \text{ kilometers.}$$

For radar station 02:

$$\Delta D_{km} = 1.25 \frac{3 \cdot 10^5}{2 \cdot 2 \cdot 10^5} + 1.3 \frac{400}{160} = 0.94 +$$

$$+ 3.26 = 4.2 \text{ kilometers.}$$

In this way, for targets dispersed in depth, the distance between groups is greater than 1.75 kilometers and less than 4.2 kilometers. If it is possible for radar station 2 to examine the target with a long-range scale at a great distance from the target, for example by delayed scanning, this should be indicated to radar station 02 in order to check the correctness of their conclusions.

Experiments in carrying out group exercises in solving assignment problems by using slides have shown that this is the most expedient method for increasing the effectiveness of command post officer training. It should also be noted that the indicated method allows an easy transition to training with the simplest teaching machines and devices designed to check the knowledge of trainees. In this case the slides and assignment problems are essentially programmed for machines.

With the employment of teaching machines and devices, the methods of carrying out group training is done as follows. The training supervisor shows the trainees a sequence with a tactical problem and poses questions. Each officer solves the problem individually and his answer is shown on his panel. The supervisor at the control panel sees the

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

results of the problem solution of each trainee. At the expiration of the time required for solving, the supervisor can listen to several persons who have incorrectly solved the problem, discuss their answers with the group, and then call upon an officer to report and substantiate the correct solution. The activity of the trainees is increased with this method of training, since each officer knows that his answer will be known to the supervisor. Here the work of each officer is actually checked, which is not possible with existing methods of training.

The new, more complex problems of training command post officers should in our opinion be resolved differently from present methods. This problem is so urgent and so important that it should be widely considered. There might also be advertised a competition for developing a "computer for radiotechnical troops officers" which would make possible the quick resolution of various tactical assignments. All of this will no doubt be of great value in the matter of raising the combat skill of radiotechnical troops officers.

The Contents of a Plan-Synopsis -- by Col S. Ye. TROFIMENKO (Pages 39-42)

Abstract:

Describes the use of a plan-synopsis for training personnel, discusses its construction, and lists individual, necessary factors to be included under its subdivisions: heading; training goal; time, place, and method of training; and material equipment. The first part is a review of previous related training; the second part is the actual conduct of the training; and the third part is the critique, question and answer sessions, discussions, etc.

(A captioned photograph by K. FEDULOV of Tech-Lt A. KRUTOGUZOV, specialist first class, appears on page 41. According to the caption, KRUTOGUZOV is preparing to enter an academy.)

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

EQUIPMENT AND ITS USE

Increasing the Technical Outlook of Future Officers -- by Maj Gen Engr Tech Serv D. G. SMILEVETS (Pages 43-47)

Summary:

To keep pace with rapid development of modern combat equipment, it is necessary to train future officers who can fully master equipment, quickly and efficiently employ it in the complex conditions of modern warfare, and instruct subordinates in its use. If there is constant improvement of the ideological-political and military-technical levels of their knowledge, officers can reach the desired goal. Our school is doing much in this direction. Increasing the technical outlook of future officers can be achieved by planned studies in special training programs and by the utilization of military technical propaganda in off-duty hours.

The students' technical outlook is defined as the sum total of their technical knowledge, as well as their knowledge in related fields of science and technology, and the ability to purposefully use that knowledge in the operation and combat application of weapons. How well the students acquire such an outlook depends on how well the schools observe the most important principle of Soviet pedagogy -- that of high ideological standards and party spirit in the educational process.

The technical knowledge of future officers depends greatly on how successfully teachers can develop the students' interests in technical disciplines. Without an interest in technical disciplines, the student will limit himself to the lectured material and will never strive to broaden and deepen his knowledge.

To increase the student's interest in his future specialty, he is acquainted with the equipment which he will have to master. Teachers direct his attention to the abundance and complexity of equipment and explain in which courses specific types of equipment will be studied.

Interest in combat equipment can be taught if each subject in radio and electrical technology, radio and electrical wiring, radar, and other special subjects, is taught on the basis of dialectical and historical materialism.

In social and economic disciplines, and at lectures and seminars on the history of the CPSU and the course of party-political work, teachers clarify their subject matter with specific examples of successes achieved.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

Teachers strive not only to enrich the students' knowledge, but also to teach them to use this knowledge in solving practical problems.

Technical conferences are one method of increasing technical knowledge. In the process of preparing for such conferences, students study books on the subject of the conference and increase the theoretical level of their knowledge.

Headquarters, the party committee, and the school's educational section attempt to create the necessary conditions for students working independently to increase their technical knowledge. Thus, the library is systematically replenished with new books on radiotechnology, electrical engineering, and various technical journals.

An officer's technical outlook is also determined by his practical skills and the teachers therefore connect theory with practice. While studying technical disciplines in first-year courses, teachers explain their subjects on actual circuits and radiotechnical installations. In second-year courses, much attention is given to parts used in radio equipment and to innovations being introduced by industries at the present time.

In practical training, attention is devoted to the detection and elimination of malfunctions in equipment. Malfunctions are initially simple but gradually become more complex and the student has to detect and explain the cause of the malfunction and repair it independently.

We created technical clubs (kruzhki) to increase the theoretical knowledge to students. These clubs have been a great help to laboratory work in perfecting training materials by making working models and other study aids.

Experience has shown that students who are active in the technical clubs, as a rule, study well, take an interest in equipment, are more skillful in detecting and eliminating defects in equipment, and actively participate in innovation work.

Measures taken in off-duty hours along the line of military technical propaganda play an important role in increasing the technical outlook of future officers. The military technical section established by the party committee has done much in this direction. The subjects of reports and lectures by section members are widely varied. The lectures acquaint the students with scientific and technological developments and help them select themes for innovation work.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

Question-and-answer evenings on scientific and technological topics are also held with us. Depending on the themes, the best specialists in the school, instructors of civilian higher educational institutions, and engineers and technicians from local industrial enterprises serve as consultants at these evening sessions.

Visual displays also play an important role in propagandizing technical knowledge. We have exhibits on "Soviet Artillery Science," "Nuclear Physics," "Rocket Equipment," "To the Stars," and others, demonstrating developments of Russian and Soviet engineering and technological ideas, and the achievements of modern science. For daily information on the most important achievements in the fields of science and technology, we have showcases on "News of Science and Technology," and "News of the Day," in which the latest Soviet and foreign innovations are displayed.

Military technical movies are an active form of technical propaganda. The content of the films coincides with the subject matter being studied at a particular time.

Military technical propaganda during off-duty hours, together with planned studies, has helped to raise the technical outlook of future officers. But a broad technical outlook is not an end in itself. It is an important means for officers to increase the combat readiness of troops and prepares graduating officers for service in on-the-job training. It is a kind of examination of preparedness of future officers to solve complex problems in training and educating subordinates after graduating from the school.

While training on the job with the troops, our students participated in the propaganda of technical and scientific knowledge among soldiers and instructed them in various subjects.

On-the-job training in chasti and especially in podrazdeleniya is also an important method of strengthening the schools' ties with the troops and makes gaps in the technical training of officers apparent. After such on-the-job training, the students' thirst for technical knowledge is noticeably greater.

Judging by the response from the troops, the majority of future officers of our school proved to be qualified specialists in practical work.

We organize the educational process by taking into account everything new which has developed within the troops and which characterizes the development of military affairs in present conditions. We understand that without a knowledge of troops and the actual conditions in which our graduates will have to work, it is impossible to train officer cadres.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

We still have shortcomings. Unfavorable criticism has been received on some of our graduates from the troops. The number of technical clubs is insufficient. A small percentage of students participate in innovation work. Question-and answer evenings are not often conducted. Slides and movies are inadequately used in support of lectures. Our club has not become a real center of military and scientific propaganda.

The staff is taking measures to eliminate these and other shortcomings and is searching for new ways to improve the training and education of officer candidates.

The methods which we have discussed can be used in the troops. Wide acceptance of such methods in podrazdeleniya would be an important means of increasing the combat readiness and the future growth of the military-theoretical, and practical knowledge of officer cadres in PVO Troops.

(A captioned photograph by Ye. FEDOROV on page 45 shows Maj G. VYLEGZHANIN working on a radar set. Described as one of the foremost students in the Military Command Academy, VYLEGZHANIN was awarded a Lenin Stipend by order of the Minister of Defense USSR.)

(A captioned photograph by A. KOZOBROD on page 47 shows Sr Lt Ye. SERGUTKIN studying political material. SERGUTKIN, commander of a podrazdeleniye, leads a group in political studies.)

<u>Everyone Needs Training</u> -- by Lt Col V. N. SAMSONOV (pages 48-49)

Abstract:

Refutes the belief that only poorly trained rocketeers need technical training sessions and maintains that regular technical training is an important means of increasing practical skills, broadening theoretical knowledge, and developing the ability to react operationally to unexpected changes in combat conditions.

<u>Planning the Use and Repair of Communications Equipment</u> -- by Lt Col G. P. BEL'SKIY (Pages 50 - 53)

Abstract:

Discusses how to plan the use, maintenance, and repair of radio communications equipment, and primarily how to prepare and use schedules and graphs for planning the use, checking, and repair of radio equipment over certain periods of time.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Radio Transmitter Equipment Checks -- by Engr-Lt Col M. S. BRYUSHINKIN (pages 54-57)

50X1

Text:

A check of all apparatus and equipment is conducted annually in the signal chasti and podrazdeleniya of our troops. Its purpose is to determine their condition according to basic parameters, to establish whether technical characteristics conform to rated values, and determine the fitness of the apparatus for further use.

Such a check is a highly effective means of controlling the combat readiness of signal equipment, since it not only detects apparatus with low parameters but also makes it possible to bring them up to the established norms. If the commissions or repair brigades are unable to do this, the apparatus is sent immediately to a repair organ.

Experience shows that timely, high-quality equipment checks make it possible to increase the interval between repairs of apparatus and signal installations by 50-100 per cent. Unfortunately, however, checks are not everywhere conducted at the proper level. We shall consider several aspects of equipment checks, especially measuring the parameters of radio transmitters.

As is well known, the following electrical parameters are measured during an equipment check of radio transmitters: current in the antenna equivalent, frequency stability, coefficient of asymmetry of output and input, chassis-to-ground resistance, and degree of distortion of the telegraph signal. In addition, the tuning of the transmitter to a regulation antenna, the operation of remote apparatus and its commutation system, and the signal distortions during keying are also checked.

The check should begin with tuning the receiver and checking its operating modes. This is performed with instruments for checking the currents and voltages of a transmitter at the same frequency bands and for the same classes of operation at which similar tests were performed at the factory. The check is made on a factory- or hand-made antenna equivalent or on an ordinary electric lamp of corresponding power.

In radio transmitters of 100 watts or more the spread of current values in tube circuits of all cascades, except the output cascades, should not exceed ± 25 per cent of the values shown in the standard regime of the log book.

A different load is permitted in the tubes of the output cascades which operate in parallel. However, the currents of their screen grids should not exceed 25 percent of the average value.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

A long run is conducted to check the stability of the modes of t50X1 transmitter. The radio transmitter should be operated for one hour with a continuously closed key and ventilation. Whenever there is a deviation from the norm of any parameter -- for example, anodic voltage -- the transmitter run is discontinued and the cause of the malfunction is determined and eliminated. In these cases it is also necessary to measure the amount, temperature, and circulation rate of water in the cooling ring of the radio tubes.

The aging of selenium washers of a VSR-type rectifier may be checked indirectly by observing the stability of the rectifier voltage. In order to do this it is necessary to tune the transmitter in a telegraph mode, press down the key, and note the magnitude of the rectifier voltage. After 15-20 minutes, another reading should be made of the same voltage and compared with the first reading. If the rectifier's selenium washers are working normally, the voltage should remain unchanged.

The power delivered by the transmitter to an antenna or its equivalent is determined by the current in the antenna equivalent and its resistance according to the formula $P = I^2R$. Many radio transmitters have antenna equivalents, and where there are none they can be made out of lamps or 60-70 ohm vitrified resistors of corresponding ratings. The current in the circuit of the antenna equivalent is measured with an amperemeter which has been checked prior to use.

After measuring the power, a check of the transmitting antennae, feeders, fairleads, and antenna switches is conducted at maximum transmitter power. The transmitter is operated for 30 minutes with a closed key. During this time special attention is given to detecting breakdowns and glowing or heating in the feeders, commutators, fair-leads and switches. Heating is checked by means of a thermometer. In measuring temperatures, the head of the thermometer should be wrapped in foil and pressed firmly against the element being tested.

The temperature of heating should not exceed the temperature of the surrounding medium by more than the following values: for commutators of short-wave transmitting antennae -- +65°C (large), +20°C (small); for switches of long-wave transmitting antennae -- +35°C; for hoses of antenna commutators -- +65°C; for rod antennae and antenna fairleads with procelain insulators +70°C; for feeders made of high-frequency cables -- not over +70°C.

The frequency stability of a radio transmitter is determined by the stability of its exciter. The principal method of accurately measuring frequencies is the method of comparing the frequency being measured to a standard frequency. The comparison is made with the frequency nearest to the frequency being measured by isolating the frequency difference and the subsequent determination of its exact magnitude. The standard frequency may also be adapted to the exact value of the frequency being measured.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

The frequency stability of the exciter is checked by comparing its operating frequency with standard frequencies of calibrators (KCh-2, KCh-1) or according to the signals transmitted by special radio stations. In working with calibrators, the voltage of the frequency being measured is fed from the exciter output into the calibrator input and the absolute instability of the frequency is determined according to the Lissajous figure. The extreme and middle frequencies of the exciter are usually tested.

If KCh-2 or KCh-1 calibrators are not available, the check may be made by comparing the transmitter frequency with a frequency of standard radio stations. These stations transmit on standard frequencies daily from 1015 to 1045 hours Moscow time. On even-numbered days they transmit on 10 mcs and on odd-numbered days, on 15 mcs. Dots are transmitted during the first three minutes and then, for two minutes, second counting, and after that, the carrier oscillations of the corresponding frequency. Using standard frequencies of 10 and 15 mcs and the harmonic frequencies of the exciter, it is possible to check the following operating frequencies: 1000, 1250, 1500, 1875, and 2000 mcs. Standard frequencies and corresponding values of exciter frequencies being checked are given in the following table:

Standard Frequency, Mcs	Frequency Being Checked, Kcs	Harmonic Number	Position of Switches			
			1	2	3	4
10	1000	10	1	1	1	4
	1250	8	1	1	4	3
	2000	5	3	1	7	4
15	1500	10	1	1	7	2
	1875	8	1	5	6	4

For conducting measurements at the input of a radio receiver operating in a telephone mode, the signals of a standard radio station are used simultaneously with signals of the radio transmitter being checked (fig. 1). As a result, a voltage with a frequency equal to the difference of the frequencies of the input oscillations will be produced at the receiver output. Another measuring process is that of determining the exact value of the difference frequency (audio) by comparison with the frequency of an accurately graduated audio-frequency oscillator. The value of the frequency received at the audio-frequency oscillator is an index of the frequency error of the signal being checked as

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

compared to the standard. When checking the accuracy of operating frequencies, the exciter and measuring apparatus should be turned on at least one hour before beginning the measurements. The sequence for measuring frequencies is as follows. First the line input of the receiver and the audio-frequency output is connected to the horizontal scanning amplifier input of an oscillograph. Next the radio receiver is tuned to the frequency of a standard signal in the telegraph mode, and the transmitter is tuned to one of the five frequencies being checked in the telegraph-frequency modulation mode with a frequency shift of $\Delta f = 62.5$ cycles per second, minimum power, and the smallest coupling with the antenna circuit.

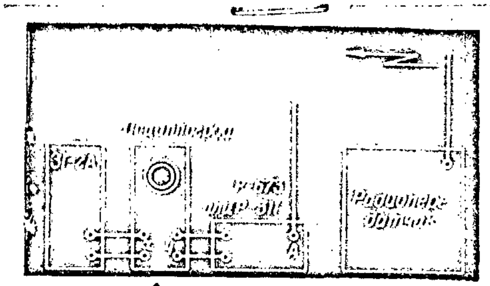


Рис. 1.
Oscillograph Radio transmitter
55

Fig. 1.

Radio transmitter

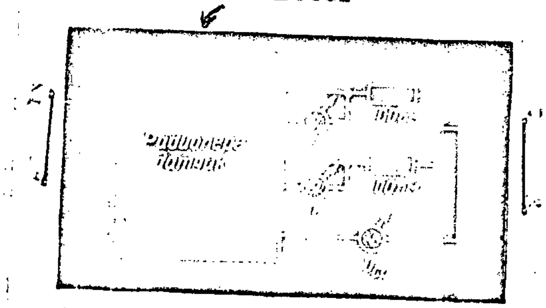


Fig.2 Рис. 2.

The receiver is then switched to the audio mode and the telegraph key is pressed down. The transmitter will emit frequency "V" and there will appear at the receiver output an audio-frequency oscillation (F) equal to the difference of the harmonics of the frequency being checked (nf_V) and the standard frequency (f_e):

$F = nf_V - f_e$, where $f_V = \left(f_{nom} + \frac{\Delta f}{2}\right) \pm \Delta f'_V$ - the error of the frequency being checked.

Following this, the audio-frequency oscillator is tuned to a frequency at which a steady figure in the form of an ellipse or circle is seen on the screen of the oscillograph.

The frequency (F) of the audio-frequency oscillator will be equal to the difference between the harmonics of the frequency being checked (nf_V) and the standard frequency (f_e). However, since $f_{nom} = f_e$, the total deviation of the transmitter frequency will be equal to:

$$\frac{\Delta f}{2} \pm \Delta f'_V = \frac{F}{n} .$$

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

[redacted]

The error of the frequency being checked with a shift of 62.5 cycles 50X1 per second is then determined by the formula:

$$\Delta f'_V = \frac{F}{n} - \frac{\Delta f}{2}$$

The frequency error with an open key $\left(\Delta f'_B = \frac{F}{n} - \frac{\Delta f}{2}\right)$ and also with frequency shifts of 125 and 250 cycles per second, is determined in the same manner.

The coefficient of asymmetry of the transmitter at the output is measured by a method employing three electronic voltmeters. The latter should have measuring limits which correspond to the voltage at the output of the transmitter being checked. To make the measurements the circuit shown in figure 2 is set up. The transmitter is tuned to an antenna equivalent R = 20 ohms (10 ohms in each shoulder), consisting of vitrified resistors rated at a corresponding power. The voltmeter readings are noted for three points of the transmitter band: the beginning, middle, and end. The coefficient of asymmetry is computed according to the formula:

$$d = \frac{1}{\sqrt{\frac{U_1^2 + U_2^2}{2U_{sr}^2} - 1}} \cdot 100\ \%$$

where U_1 and U_2 are the voltmeter readings in volts and U_{sr} is the reading of the voltmeter inserted between the artificial midpoint and the chassis of the transmitter.

The value obtained for the coefficient of asymmetry should not exceed 2 - 3 percent.

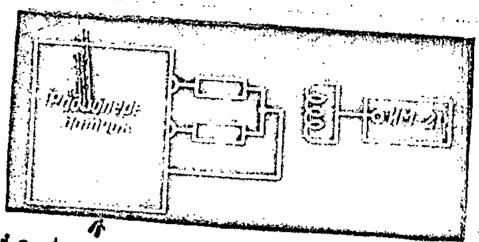
The modulation factor of the transmitter is determined by working with the microphone or laryngophones of the set. An IM-21 (IM-8, IM-18, IM-13) is the measuring instrument used. The modulation factor is measured at the lowest frequency by the circuit shown in figure 3.

The radio transmitter and modulation lines are checked with a signal generator or dot-pulse generator. The transmitter of an II-57 may also be used. The transmitter or generator is set up at the modulation point and the radio transmitter is tuned in the usual manner to one of the operating frequencies. Next, the generator is switched on at the modulation input of the transmitter. Its modulation speed is adjusted according to the oscillograph to a point at which a distinct and steady impulse signal, supplied at the modulation input, appears on its screen. The shape of the signal fed from the transmitter should be rectangular, without distortion, and its length should correspond to the duration of the spacing (fig 4).

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1



Radio transmitter Рис. 3. IM-21

56

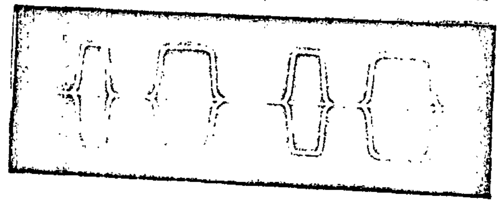


Рис. 4. Нормальная форма телеграфного сигнала.

Fig. 4. Normal shape of telegraph signal.

Following this, a comparative check of the shape of signal received at the transmitter output is made. For this an oscillograph is connected to the modulation point at the input of a radio receiver tuned to the frequency of the transmitter.

The signal received from the transmitter output should not differ sharply from the signal given off at the input. A slanting front of signal build-up, dips in its horizontal part, a sharply expressed bias or breaking down of the signal indicate a malfunction of the transmitter: for example, in the filters, in the circuits of the output cascade power supply, in the keying relay, etc.

The characteristic shapes of signal distortion resulting from frequently encountered malfunctions of radio transmitters are presented in figure 5. It should be noted, however, that the check will be valid only when the modulation lines and radio receiver in the checking circuit have been checked and corrected prior to the check.

If an II-57 is available, it is possible to determine the amount of distortion and the presence of characteristic distortions in the transmitter, if the latter occur.

This method of checking is also a good check to use during daily work. With gradually accumulated experience and factual data, which give a picture of the characteristic malfunctions of a transmitter on an oscillograph installed at the modulation point, it is easy and quick to check any radio transmitter and determine its technical condition.

The chassis grounding of the transmitter remains to be checked. This is very important because there are cases in which, for one reason or another, a high voltage passes through the chassis, presenting a serious danger to the operator and possibly resulting in injury from a high-voltage current. To prevent this the radio transmitter must be carefully grounded and the condition of the grounding systematically checked.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

The quality of the chassis ground is checked with an ohmmeter by connecting the leads to the "Ground" terminal of the transmitter and to the busbar of the transmitter ground. The ground is considered fully satisfactory if the measured chassis-to-ground resistance does not exceed 0.03-0.04 ohms.

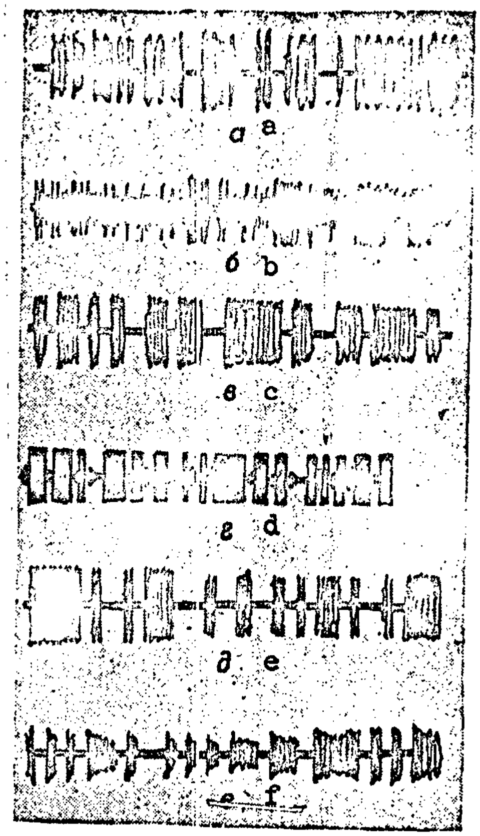


Fig. 5.

a - spurious modulation of an AM signal by an alternating current with a frequency of 50 cycles per second; b - modulation of signals of DChT by an alternating current with a frequency of 100 cycles per second and a modulation of M-40%; c - spurious double modulation of signals of a start-stop apparatus with a frequency of 50 cycles per second and a modulation of M-30-50 %; d - spurious radiation in the spacings; e - premature unlocking of a transmitter after spacing; f - poor tuning of the transmitter.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

Regardless of the results of the measurement it is necessary to carefully and systematically check the entire grounding system of the radio transmitter. Constant control over this system may be accomplished by checking the quality of radial beams, ground busbar, and busbar connecting the transmitter with the total system. The checks are made by random inspection of the beams and the shape of the collecting bar.

Experience in the maintenance of signal equipment in the leading podrazdeleniya shows that annual equipment checks in conjunction with high-quality daily service and well organized inspections make it possible to increase the interval between repairs and the reliability of radio transmitters.

Methods for Extending Engine Operation Periods Between Overhauls -- by Engr-Capt V. A. OKHRIMENKO (Pages 58-60)

Text:

A patriotic movement is spreading among the personnel of radio-technical troops chasti and podrazdeleniya for exemplary servicing of equipment and for carrying out maintenance without the aid of KRAS (field maintenance shop personnel?). Many radar station crews have pledged to extend operation periods between overhauls for the equipment which they use and to economize fuels, lubricants, and other materials. During this socialist competition, the technical levels of equipment servicing have been noticeably raised and the quality of maintenance work has been improved. However, in spite of the results achieved, equipment occasionally goes out of order during operation. This has happened predominantly with electric power supply equipment.

Analysis of the defects shows that most of them could have been prevented by timely maintenance work and by observance of the rules for turning equipment on or off. We will consider in greater detail the reasons for the occurrences of malfunctioning.

Defects in the mechanical parts of electric power assemblies are usually due to mechanical wear in which parts change their original dimensions and shapes and also due to disturbances of adjustments because of weakened fastenings, breakdowns, and deformations of parts from incorrect use.

Whole assemblies go out of order when individual mechanisms fail, especially when connected parts fail. Failure in connected part couplings occurs because of changes in the characteristics of the coupled parts, i. e., when settings are exceeded. For example, if an engine does not develop a required power setting, the reason can be

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

that the connection characteristic is disturbed between the cylinder and piston rings, the piston and piston rings, piston and cylinder, etc. Change in this coupling characteristic of joined parts occurs because the dimensions and shapes of these parts are changed: the cylinder diameter is increased, the piston diameter is decreased, the shape of either of the parts is altered (ovally, or conically), and they become defective.

Practice shows that the wear of parts and mechanisms is not equal in absolute value, and at various stages occurs at different rates, with equal numbers of operation hours, when using even a single-type assembly under various load conditions including temperature and other factors. A curve showing the build-up mechanical wear of connected parts depending upon time is shown in figure 1. It is typical for most of the connected parts of electric power assemblies.

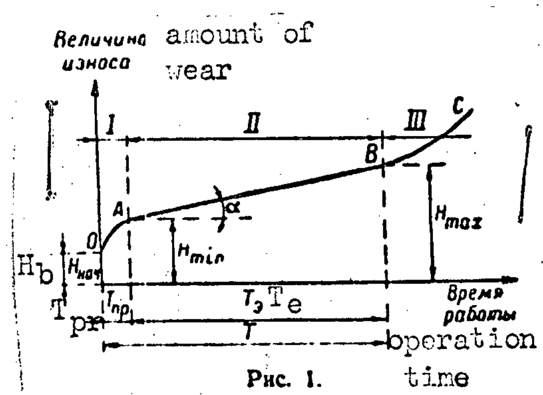


Figure 1.

The curve is clearly divided into three parts. In the first period (OA) intensive wear occurs chiefly because of smoothing down and abrasion of uneven part surfaces and wearing-in of friction surfaces. In the second period (AB) natural wear of parts occurs. Here, wear slowly increases during the lengthy period T_e. Therefore, the curve which characterizes the growth of clearances has a straight line part. The third period (BC) conforms to the progressive increase in the wear of parts with clearances between them increasing sharply. Connected parts begin to work noisily and then begin to knock. If preventive measures are not taken, further use of the assembly can lead to breakdown. Wear during this period is termed injurious.

To evaluate the periods of service between overhauls, the third part is excluded since the end of normal operation of a connection must be considered as the attainment of the limit of allowable wear. Therefore, the time of service for any connection operating within an established regime can be expressed by the following relation:

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

$$T = T_{pr} + T_e;$$

$$T_e = \frac{H_{max} - H_{min}}{tga};$$

$$T = \frac{H_{max} - H_{min}}{tga} + T_{pr}$$

where T is the period of service time between overhauls for a connection;

T_{pr} is the time of assembly run-in (the time for breaking in the connected parts;

T_e is the time of normal service of the connected parts;

H_{max} is the allowable reduction of setting through wear (allowable wear);

H_{min} is the clearance of the connection after break-in;

H_b (shown in fig. 1) is the beginning clearance of the connection;

tga is the value which characterizes the intensity of connection wear.

From the indicated relationship, an assigned period (T) between overhaul periods of a connection can be derived by maintaining the value of the numerator and the denominator of the first term of the equation within required limits, since T_{pr} is constant. Measures taken to maintain an intensity of wear (tga) at a level no higher than normal are in the realm of usage, and measures taken to maintain a certain limit to fitting expansion (H_{max} - H_{min}) are in the realm of repair. Naturally, all specialists are interested first in measures taken during usage since questions of repair cannot be fully resolved under field conditions.

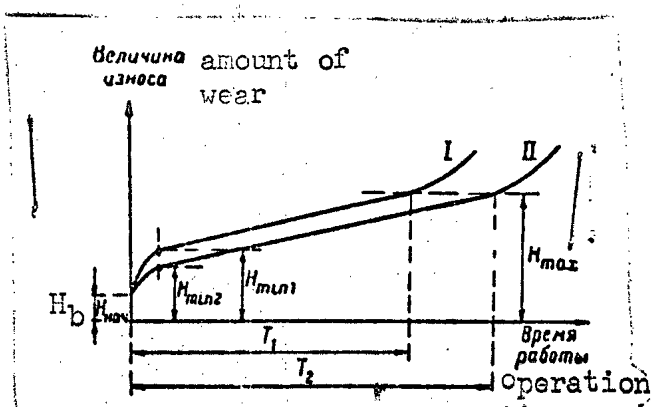


Рис. 2.

Figure 2.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

We will consider in more detail how the amount of wear during break-in influences the period between overhauls. The increment curves for wear of two identical working pairs are shown in figure 2 with the exception that the pairs are broken in under different conditions. The conditions for breaking in pair II were better than those for breaking in pair I. Thus, when compared, there is a small difference in wear at the end of the break-in period ($H_{min1} - H_{min2}$) and the time interval between overhauls for pair II (T_2) is significantly greater than the corresponding T_1 for pair I.

This illustrates how the breaking-in period for electric power equipment plays an important role in prolonging its period of service between overhauls. This is why all new or reconditioned equipment must be broken in under the most favorable conditions. Therefore, careful oiling of the system and filter elements, more frequent oil changes, and strict observance of operating temperatures during breaking-in periods are very important.

From the relationship which we considered earlier, it is also evident that the interval between overhauls is increased if the amount of the intensity of wear of a connection is reduced. To do this during usage, it is necessary to develop the best possible conditions of lubrication, temperature, and load for the working parts of components and mechanisms. As shown by experience, such results can be achieved if high quality fuels and lubricants are used (fuel and oil should be clean and conform to the All-Union State Standard which applies to the servicing instructions), if the equipment is properly lubricated, and if the oil and filter elements are replaced and the equipment is greased at the proper times.

It is also required that optimum temperature and load conditions be maintained to decrease scale formation. Specified clearances must be adjusted carefully and at the proper time, while rules for starting, for switching on loads, and for operation are strictly observed. If the equipment is idel for long periods, the rules for equipment storage must be strictly observed.

The unrequired dismantling and reassembly of mechanism parts has an influence on the amount of wear of connections. Actually, each dismantling is connected with some disturbance of break-in procedures and with a necessity for repeating the break-in process due to poor fitting of parts, to improper tightening of bolts, etc. It is important to keep in mind that during the breaking-in process, uneven "crusts" of metal layers must be removed. A comparison of two curves showing the wear of identical connected pairs is shown in figure 3. The operating conditions for these pairs are identical except that the first connection (its wear is shown by curve I) is disassembled and reassembled during the usage period, which does not occur with the second connection (its wear is shown by curve II).

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

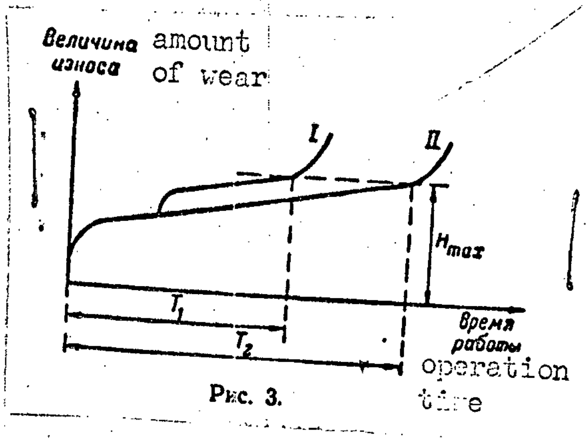


Figure 3.

As is evident from the figure, the service time of the first connection T_1 is significantly less than the time of service for the second connection T_2. Therefore, it cannot be considered normal when power mechanism parts are dismantled only to check their condition, but unfortunately this occasionally happens in actual practice. Such "maintenance" is far from proper care for equipment preservation. This is why it is necessary that new methods for determining the condition of engine and generator parts be examined and that those already developed be publicized. Examples of such methods include listening to parts connections with a defectophone, checking temperature alteration, and readings of check instruments, etc. Technical literature should also publicize and discuss means of removing scale from the surfaces of combustion chambers, pistons, and piston rings without tearing the engine down.

Measures taken to facilitate starting and to decrease the time required for engine warm-up are important to prolong the service time of engines between overhauls. It must be noted here that starting, stopping, and operating an engine which is not properly warmed up is inevitably connected with operation under faulty lubrication conditions. At such moments maximum engine wear is achieved. Therefore, the number of starts before an engine is warmed should be strictly limited. Measures to facilitate starts and speed up warm-ups are well known. Equipment should always be maintained in a technically correct condition, its assembly should have accessory heating elements, the engine thermostat should be readily accessible and in proper operating condition, etc. To aid in engine warm-up, under winter conditions it is recommended that there be a radiator thermostat and that the engine be preheated before starting.

It is strictly forbidden to use unspecified devices with low ignition liquids for starting diesel engines, since this can lead not only to damage of diesel parts, but to accidents.

The continually growing skill of our electricians and mechanics, the increase of their technical knowledge, and the constant development

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

of equipment make it possible at this time to consider each failure of electric power equipment as an unusual occurrence. Each breakdown and all abnormal wear observed in mechanisms must be thoroughly studied to establish the reasons for their occurrence. Without this, it is not possible to take measures to prevent similar occurrences in the future. Thus, sufficiently effective methods are available to radar station crews which, if skillfully used, make it possible to maintain high and constant combat readiness of podrazdeleniya, to lengthen the periods between overhauls, and to conserve all motorized equipment, fuels, and electric power equipment.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Aircraft Fuel Systems -- by Engr-Col N. Ye. ZHOVINSKIY, Candidate of Technical Sciences (Pages 61-66) 50X1

Text:

Studying the subject, "Aircraft Fuel Systems," will help flight personnel gain a good understanding of the operation of the system on which flight reliability and safety depend to a significant degree. A knowledge of fuel sequence and the ability to check reserves in the tanks quickly, play an important role in employing the aircraft's performance characteristics.

For a good study of the subject, visual training aids must be constructed -- a line diagram of the fuel system, diagrams of the operation of individual units (valves, booster and transfer pumps), the compartment of negative G-forces, the drainage system, and the pressurizing system), and cutaways of assemblies and mock-ups. Moreover, there should be visual training aids on the placement in the cockpit of fuel control instruments, warning signals (lights and signal lamps), and operational controls of the system.

Six hours are set aside for studying the subject, i. e., three lessons of two hours each. How should each lesson be organized and on which problems should the instructor concentrate his attention?

The first lesson should be an examination of the function of the system, the makeup and arrangement of parts, basic technical facts, and the operation of the system. The primary functions of the fuel system include the following:

Constantly supplying fuel to the engine in any flight conditions and at various engine operating modes. The section of the fuel system from the service tank to the engine pump fulfills this function. Here the instructor should point out that drainage and pressurizing systems, which will be examined later, exert a great influence on ensuring fuel supply to the engines.

Ensuring the assigned distance and duration of flight. This depends on the weight of the fuel supply on board the aircraft, i. e., on the capacity of the system and the specific gravity of the fuel. Flight profile and attitude, and engine operation, which relate to the subject of distance and duration, ought not to be examined here.

Maintaining aircraft balance within the tolerable limits during in-flight fuel consumption. This is caused by the automatic system of fuel expenditure from different tanks according to a specific program.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

Thereupon, the instructor should draw student attention to measures associated with the dependability and safety of system operation and to the means of accomplishing preflight and in-flight control of its operation. For this, the physical aspects of the system, the location of filler openings and drainage openings, the arrangement of units, and system control and inspection instruments should be examined.

After this, attention may be turned to an examination of the operation of the fuel system, pointing out its special features and the complex conditions in which it is found.

As is well known, a modern aircraft flies in various conditions which can change quickly. Possessing a high rate of climb, the fighter gains altitude in a short time, during which the pressure in the fuel system changes. In some cases, the pressure drop on the fuel surface can lead to an interruption in the operation of the fuel system.

When executing maneuvers, G-forces are created which effect the entire aircraft, including the fuel system. Negative G-forces, for example, can lead to a disruption of fuel feed from the tanks to the aircraft system as a result of the flow of the fuel from the lower part of the tank. To eliminate this, negative G-force compartments were mounted in the lower part of service tanks on fighters.

During engine operation and under the effect of aerodynamic loads, vibration loads are created on aircraft which also effect the fuel system. Fuel expenditure on an aircraft widely varies, depending on the engine operating conditions, and increasing as much as 10 to 15 fold. In these conditions, the fuel system must possess the necessary pickup to ensure the supply of as much fuel to the engine as may be required at the time. Aircraft fly at various altitudes and in a wide range of air temperatures -- from minus 60°C to the high temperatures caused by aerodynamic heating.

An examination of the features of fuel system operation during flight at high altitudes must begin with an analysis of the physical phenomena originating in the fuel. In any liquid, as is known, evaporation occurs, the intensity of which depends on the temperature. The specific tension of the vapor corresponds to the temperature of the liquid. The closer the pressure over the surface of the liquid is to the tension of its vapor, the more intensive the evaporation. When vapor tension exceeds pressure, the liquid begins to boil rapidly. Gases dissolved in the liquid can escape under lower pressures than those at which the liquid boils. Consequently, as altitude is increased, the liquid in the fuel system may begin to boil.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

When liquid is flowing in the fuel pipes, pressure gradually drops because of hydraulic drag. In front of the pump, the pressure in the fuel pump delivery line is lower than in the beginning of the pipe. However, even if the fuel pipe is located directly in the tank, the pressure in the suction cavity will be lower than in front of the pump because of the inflow of fuel. When there is low pressure over the liquid in the suction cavity, there may be an intensive evaporation of the liquid and an escape of air and other gases dissolved in it. A spray of liquid may burst out and the fuel flow and the pressure created by it might fall to zero, that is, so-called cavitation might ensue. This phenomenon is accompanied by the appearance of noises in the pump and jolting and interruptions in the operation of the fuel system, possibly even engine failure in flight.

Cavitation occurs in the suction chamber of the pump in the event of a pressure drop to an amount equal to the vapor tension of the liquid, when there is dissolved air or under higher pressures. Hydraulic drag and oil drainage may occur between the pump inlet and the suction chamber causing the phenomenon of cavitation. Moreover, when pressure in the suction chamber drops, leakage occurs from the high-pressure chamber through the clearance gaps during intake. To decrease the leakages, it is necessary to have some overpressure.

Thus, to create normal conditions for operation of the pump, it is necessary to create pressure in front of the pump which exceeds the vapor tension. The minimum amount of overpressure which provides constant operation of the pump is called a cavitation reserve of pressure.

Based on these statements, it can be concluded that pressure in front of the pump should be no less than vapor tension plus cavitation reserve. It should be noted that during high-speed revolving of the oscillating unit, high pressures created by the pump, and large expenditures of fuel, the pressure requirement in front of the pump increases. While pressure in front of the pump for old types of jet engines, the VK-1 for example, should be approximately 0.3 kg/cm^2, it is more than 2 - 2.5 kg/cm^2 for modern engines. On old aircraft it was possible to create overpressure in front of the pump merely by means of a booster pump, but on modern aircraft a multistage increase of pressure in the section from the tank to the primary pump is used to create the pressure requirement in front of the pump. This is accomplished in the following manner. An auxiliary pump is mounted in the engine which creates pressure overcoming the hydraulic drag of the system located between the auxiliary and primary pumps and sufficient for the normal operation of the primary pump. Usually located in this section of the system are; flowmeters, shut-off cocks, and, in some cases, fuel-oil coolers and other units, in addition to pipe lines.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

However, to ensure that the auxiliary pump located in the engine 50X1 can operate normally, it is also necessary to provide a specific amount of pressure in front of it equal to the vapor tension plus the minimum cavitation reserve required for operation of the pump, as instructed previously. The auxiliary pump can operate in several modes -- under small expenditures of fuel, and even in conditions of small vacuums; but under large expenditures of fuel, a specific overpressure in front of the pump is required. This leads to the following rule which confirms the above statements: the absolute auxiliary pressure in front of the pump should be no lower than 0.6 - 1.2 kg/cm^2, depending on the mode of operation.

Since in high altitudes the pressure of atmospheric air may drop to very low quantities, (here the training instructor ought to use the graph of changes in atmospheric pressure at different altitudes, based on data of the international standard atmosphere shown in figure 1), a booster pump is installed in the fuel system service tank to ensure the operation of the pump. On high-performance aircraft, this pump is usually mounted in the negative G-forces compartment and creates overpressure of 0.6 - 0.8 kg/cm^2.

Here, it should be indicated what distinguishes absolute pressure from overpressure and what it amounts to in the booster pump. It consists of the pressure in front of the pump inlet and the overpressure created by it:

$$P_{np} = \Delta P_{np} + P_b,$$

where P_{np} -- absolute pressure created by the booster pump,

ΔP_{np} -- overpressure created by the booster pump,

P_b -- tank pressure.

After that, the work of the booster pump should be examined.

Just as with any pump, the booster pump can work only when the pressure in front of it exceeds the fuel vapor tension by the amount of the minimum cavitation reserve requirements for the pump. Depending on the type of the booster pump being used, the pressure requirement in front of it should be no less than 60 - 150 mm of mercury, which is 0.08 - 0.2 kg/cm^2. Under lower pressure, the pump begins to work in cavitation modes which leads to a break in fuel feed to the engine, to breaks in its operation, and even to failure in flight.

The problem of creating normal conditions for work of the booster pump should then be examined. Using the graph of changes in atmospheric pressure at different altitudes (fig. 1), the pressure requirement in front of the booster pump at each altitude should be indicated. After taking several values of the pressure requirement in front of the booster pump as examples, it is possible to find the

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

altitudes up to which the pump could work if there were no increase tank pressure. For example, an altitude of approximately 10,000 meters corresponds to 60 mm of mercury of required pressure, and 12,000 meters corresponds to 150 mm of mercury. If the pressure in front of the pump should be no less than 200 mm of mercury, then the pump, with no overpressure in the tank and a small amount of tension acting on the fuel, will no longer work at an altitude of approximately 10,000 meters.

The use of fuel with a high vapor tension lowers even more the altitudes up to which the work of the fuel system is ensured. Here it is pertinent to examine the problem of how to provide for normal operation of the booster pumps at greater altitudes. It should be pointed out that the pressure in the fuel tank, P_b, should be no less than the minimum pressure requirement in front of the booster pump P_{pot} ($P_b \geqslant P_{pot}$), and the tank pressure is equal to the external air pressure at given altitude P_p plus overpressure (P_b) Δ.

$$P_b = P_p + \Delta P_b.$$

Furthermore, using figure 1, one should point out what the overpressure in the tank should equal when the pressure requirement is achieved. Having assigned the pressure requirement in front of the pump and the altitude of the flight up to which it is necessary to ensure operation of the booster pump, and, subsequently, the work of the entire fuel system, it is possible to find the tank overpressure which satisfies the prescribed conditions. Let us assume that $P_{pot} = 150$ mm of mercury and flight altitude $H = 20$ km. Reading as indicated in figure 1 by the arrows, we receive the required tank overpressure as $\Delta P_b = 110$ mm of mercury, or 0.15 kg/cm^2.

It is easy to show by this exampl why increased pressure in fuel tanks is used in the fuel systems of modern aircraft.

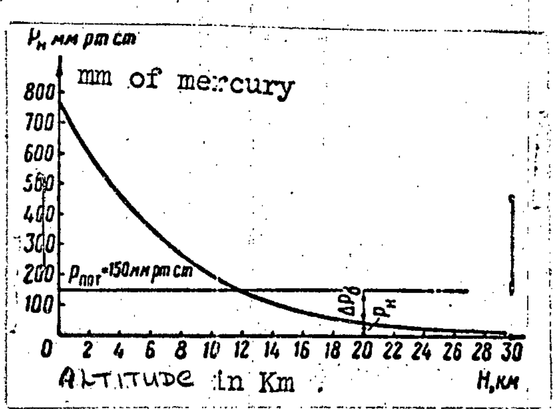


Fig. 1.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

In those cases where fuel is supplied to the service tank, for example from the drop tanks, not by means of fuel transfer pumps, but as a result of overpressure caused by forced explusion, it is necessary to explain to what the overpressure should be equal. Since in the service tank there is P_b, as explained earlier, for the purpose of feeding fuel into it from other tanks, especially those situated lower than the service tank, it is necessary to creat specific overpressure in them. It should be sufficient to raise the fuel to a height corresponding to the difference of the levels between the lower part of the tank, from which the fuel is transferred, to the level of the fuel feeding into the service tank, considering the actions of G-forces on the aircraft, and the overcoming of hydraulic drag and overpressure in the tank. The following data, which are easy to calculate, may be adduced. The auxiliary pressure required for raising the fuel one meter, considering G-forces, is 0.07 kg/cm^2 and the hydraulic drag of one meter of pipe is approximately 0.02 kg/cm^2.

Breaking the hermetic sealing of the pressurizing system can lead to breakdowns in the order of fuel expenditure from the tanks, and can confuse the pilot with regard to the aircraft fuel reserves. Therefore, much attention must be given to the condition of the pressurizing system and to tight closing of the tank fillers.

The training instructor, having the graph of atmospheric changes and knowing the pressure requirement in front of the booster pump, can easily show how much the tolerable altitude can differ with a failure in the pressurizing system, similar to determining the required amount of overpressure in the tanks. Using data from the standard atmospheric chart, with different pressure requirements in front of the booster pump and an absence of overpressure in the tanks, the maximum altitude up to which normal operation of the fuel system is possible, can be obtained from the following table:

Required pressure in front of the pump (mm on the mercury column)	200	175	150	125	100	75	50
Maximum flight altitude (meters)	9800	10700	11800	12800	14200	16000	19000

Attention must be given to the very important circumstances which effect booster pump operation conditions and the entire fuel system. The altitude indicated in the table up to which the fuel system can operate relates to a horizontal flight attitude. When the aircraft gains altitude and when there is no overpressure in the fuel tanks in front of the booster pump, failures in the operation of the fuel system might begin at significantly lower altitudes. What is the reason for this phenomenon? There can be a diverse quantity of air in a dissolved state in the fuel amounting to 12 or 13% by volume, depending on the pressure. When altitude is gained gradually with slow vertical speed, the air dissolved

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

in the fuel gradually escapes and does not affect the operation of th50X1 fuel pump. The lower the pressure, the less dissolved air in the fuel. With increased pressure in the tank, the separation of the air also does not affect the operation of the pump. The training instructor can explain what happens in the fuel system during fast vertical speeds and failures in the pressurizing system.

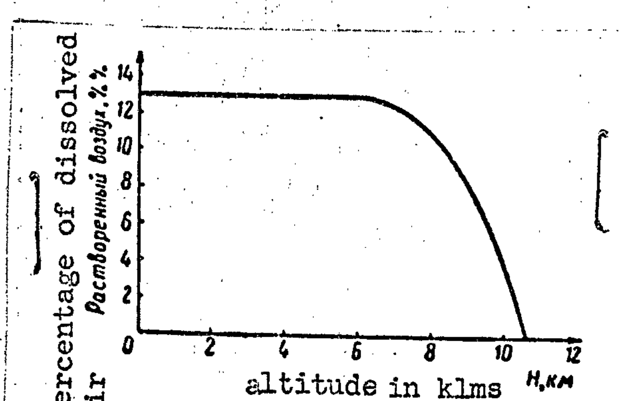


Рис. 2.
Fig. 2

In figure 2, a graph shows the changes in percentages of air dissolved in the fuel, depending on the altitude. As the graph indicates, beginning at an altitude of approximately 6 kilometers, the percentage of air drops. In conditions of high climbing speeds (during the first altitude gain when the air has not yet escaped from the fuel) and the absence of overpressure, there is a sharp change in tank pressure and the booster pump creates an additional vacuum. The air which did not separate from the fuel begins to escape intensively in front of the pump, interfering with its operation. Moreover, failures in engine operation are possible at altitudes of approximately 7 - 8 kilometers. At lower altitudes, these phenomena do not occur, nor do they in subsequent altitude gains.

Here the importance of retaining overpressure in the fuel system should be emphasized once again, especially since a number of failures occur in the drainage and pressurizing systems. This determines the necessity of increased attention to the work of fuel system technicians in preparing aircraft for flight and to preventive maintenance and repair work. Accuracy in preparing and servicing the fuel system depends on a knowledge of both line and wire diagrams of the system, principles of the operation and construction of assemblies and elements of the system, and a knowledge of basic factors which characterize the work of the fuel system.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

During the lesson, a number of questions might be brought to the student's attention. What are the peculiarities of fuel system operation in high altitudes? Why is it necessary to have increased pressure in the fuel system? What effect does a loss of airtightness in the pressurizing system have on flight altitude?

We dwelt at such length on the subject matter of the first lesson because the problems studied in it are the most complex on the subject.

In the second lesson, the following problems should be studied. 1. The line diagram of the fuel system and the sequence of fuel expenditure. 2. Booster and transfer pumps, valves used in the transfer system, and their reciprocal operation. 3. In-flight operation of the system under negative G-forces.

Begin the study of the line diagram with the arrangement of fuel tanks and units on the aircraft. First of all, it must be explained that tanks are located at various distances from the aircraft's center of gravity. Facts on the capacity of each tank must be cited. By citing specific facts, it is easy to show that fuel expenditure from tanks of different capacities, especially those located at different distances from the center of gravity, would inevitably lead to a change in aircraft balance which must be within definite limits. Therefore, a definite sequence of fuel expenditure from the different tanks must be provided. It can be explained that on all aircraft with one engine, the fuel feed comes from the service tank. Fuel expenditure from other tanks is conducted by transferring it into the service tank by means of fuel transfer pumps, or from several tanks by means of pressure outflow due to increased pressure in the tanks.

When using the line diagram of the fuel system, the study should begin with the section from the service tank to the pump located in the engine. First of all, it is necessary to show the path of the fuel through the compartment of negative G-forces to the pumps located in the engine, and the operation of the booster pump which creates the necessary pressure for overcoming hydraulic drag in the aircraft fuel system and for providing the required pressure in front of the engine auxiliary pump. Then a study of the function of the units located in this section of the system and their effect on the reliability of operation of the entire fuel system should follow. Reliability of system operation also depends on the action of the units in the fuel transfer system. Inasmuch as the fuel transfer pump must provide fuel feeding for maximum fuel consumption, the consumption of fuel from the service tank will be less than the flow of fuel to it under slower engine operating modes. This could lead to an overflow in the service tank, and increase in service tank pressure, to partial ejection of fuel through the safety valves, and even to destruction of the tank. To avoid such occurrences, fuel feed into the service tank is regulated by a specific program.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

How the transfer of fuel in the system is accomplished and what fuel expenditure program is must further be explained, and all variants of transfer, the operation of the transfer system units, and control of their operation must be examined.

It is important to bear in mind the basic problems of fuel system maintenance, from preflight preparation of the fuel system to the preliminary preparation. Flight personnel must know not only the rules of in-flight system maintenance, but also the preflight preparation procedures, and they must be able to make check-outs and refuel. Pilots must gain a good understanding of the system in order to correctly analyze and evaluate in-flight operation and make fast, accurate decisions when malfunctions occur.

The instructor should pay attention to a number of important conditions which ensure reliability of the fuel system, particularly to the nonpermissible entry of water into the fuel in winter and mechanical impurities in summer.

Water may exist in fuel in a suspended state as an emulsion or in a dissolved state. In low temperatures, it may precipitate in the form of crystals which fall onto the filter and sometimes causes congelation of the filter and interruptions in fuel feeding. Therefore, the requirement on checking fuel in winter for the absence of water and draining sediment from fuel vessels and lower points in the system must be strictly observed. In summertime, difficulties of another type may occur. When taking off from dusty airfields or from dirt fields, dust may get into the engine, part of which filters through the pressurizing system into the fuel tanks, because air is fed into the fuel tank by the engine compressor. From the tanks, the dust may get into the pumps and the fuel regulator together with the fuel, causing failures in the engine fuel system. Therefore, in summertime special care must be taken to see that there are no mechanical impurities in the drained residue.

In the section of the fuel system from the service tank to the pump, with the mainline in good repair, the distinguishing characteristics of the system are tank overpressure and a properly functioning booster pump which is checked by means of lights. They are turned on from a pressure signal component installed behind the pump.

When studying the operation of individual units of the fuel system, the instructor must dwell on their reliability and the measures taken to increase the life of the system. While studying the operation of the booster pump, attention must be paid to the presence of an auxiliary stage impeller in front of it, the function of which is to separate the air from the fuel, to decrease losses in front of the inlet to the centrifugal stage of the pump, and to create some hydrostatic head in front of it.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

In addition, the operation of the system when the booster pump fails, the course of the fuel in this event, and the elimination or decrease of hydraulic drag when the pump is stopped, must be studied. Together with this, it is especially necessary to examine the operation of the compartment of negative G-forces, its capacity, and its useful life under the effects of negative G-forces and other factors.

During the lessons, the students' mastery of the questions examined can be clarified by informal question periods. What is the sequence of fuel expenditure from the aircraft tanks and for how long is it provided? How does the booster pump operate? How and for how long is fuel supplied to the engine in a flight with zero or negative G-forces?

The third lesson should be devoted to an examination of the following topics: 1. The system of draining and pressurizing fuel tanks. 2. Checking the operation of the aircraft fuel system. 3. The gasoline system. 4. Maintenance of the fuel system. 5. A study of the fuel system on an aircraft.

Since pressure requirements for fuel tanks were studied in previous lessons, the system of draining and pressurizing fuel tanks must be studied in this lesson. For a correct understanding of the subject, drainage working conditions must be analyzed. On modern aircraft, impact pressure is usually used to increase pressure, but in those cases when it is insufficient (slow speeds or high altitudes), -- increased air pressure is usually yielded by an engine compressor. However, flying at low altitudes with fast speeds can lead to an excessive increase in tank pressure. The utilization of air yielded by the compressor may produce similar results. It is known that reducers and safety valves, which support the necessary tank pressure drop, are installed to eliminate this. A return valve, which is covered when a decrease of impact pressure is lower than the specified amount, is installed in the mainline. It would seem that with pressurization it would be possible to manage without a drainage mainline. This problem must be studied by examining diving or steep gliding from high altitudes.

At high altitudes, tank pressure is equal to atmospheric pressure plus overpressure. Suppose an aircraft sharply descends. In this event, external pressure grows very quickly. To ensure that the necessary pressure drop in the tanks is maintained and no vacuum is created, it is necessary to supply a large quantity of air, especially when there is a small reserve of fuel in the tanks. To supply such a quantity of air from the air is impractical, not to mention the bulk of reducers and safety valves which would be needed in this case. The task of replenishing fuel tanks during dives or steep gliding is solved successfully by the drainage system, a section of the tubes of which is specially selected for preservation of the normal conditions of fuel system operation, and a sample of the air is brought out on the spot ensuring the necessary

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

utilization of impact pressurization.

Further, the students' attention must be turned to checking the operation of this system since failures in its units can lead to interruptions in engine work or to the necessity of changing the flight to slow speeds.

Studying the remaining problems does not present any particular complications, but it would be desirable to study them directly on the aircraft, relating the problems of checking the system and its utilization to the pilot's actions in the cabin.

(A captioned photograph by K. ARSEN'YEV on page 66 shows Engr-Capt L. BIRBRAYER checking the work of Reenlisted Sgt G. GARIPOV, a mechanic. Personnel of the TECH commanded by BIRBRAYER execute repair work in an exemplary manner and maintain aviation equipment in a state of constant combat readiness.)

Power Gyroscopic Stabilizers -- by Engr-Col V. I. UKRAINTSEV (Pages 67-71)

Abstract:

Based on foreign press materials, discusses the operation and construction of one-, two-, and three-axis gyroscopic platforms used to stabilize rockets in relation to the Earth.

Infra-Red Radar System -- (Page 71)

Abstract:

Reports the US development of a combination infra-red and radar tracking system designed to track ballistic rockets from the moment they are launched. The source for the report was given as Interavia Letter.

CYBERNETICS AND AUTOMATION

The Arithmetic Unit of an Electronic Computer -- by Engr-Lt Col A. V. SEREBRYAKOV (Pages 72 - 76)

Text:

One of the first questions which inevitably arises in learning the basic principles and ideas of the operation of electronic computers (EVM) is how arithmetic work or operations are done by the computer. It is known that these operations are performed by what is called an arithmetic unit (AU). This article will present to its readers an example of a

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

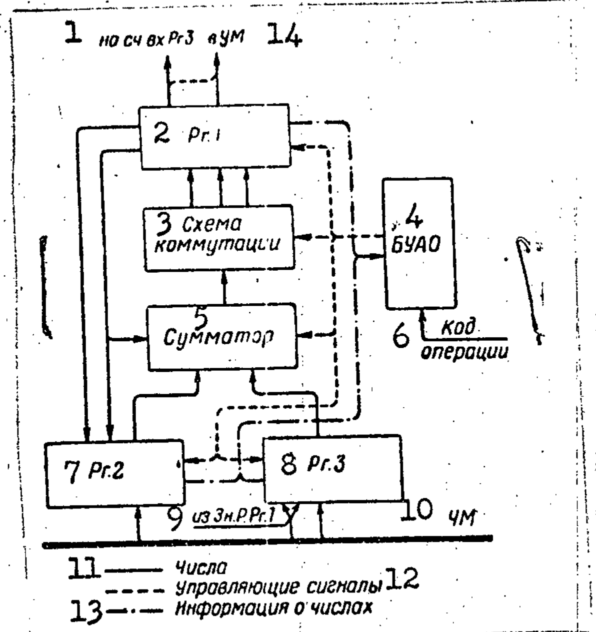
Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

widely used variant of an arithmetic unit and its means for performing 50X1
basic arithmetic operations.

An arithmetic unit is used to complete operations of addition ("Sl"), subtraction ("Vch"), multiplication ("Um"), and division ("Dl") of n-digital binary numbers with a fixed point. This unit can also be used to perform many logical operations on numbers, in particular module comparison, formation of new numbers from two initial numbers separation of a number quotient, shift of a number to any digit quantity, etc.

An arithmetic unit consists of an arithmetic operations control block (BUAO), three registers which are units for number storage, an adder (ξ), and commutation circuits (see figure).

The numbers on which operations are performed are fed into the arithmetic unit from a multi-column numerical main (ChM) and commands for execution of an operation (operation code) are supplied from the machine central control unit. The numbers in the numerical main are represented by a potential code as numbers with a point fixed after a sign column, i. e., as a proper fraction. The numerical main is composed of one sign and an odd quantity (n) of mantissa columns.



1. to computing input register 3; 2. first register; 3. commutation circuit; 4. arithmetic operations control block; 5. adder; 6. operation code; 7. second register; 8. third register; 9. from sign columns first register; 10. numerical main; 11. numbers; 12. control signals; 13. number information; 14. to numerical main.

All of the arithmetic unit registers are for storage of numbers which are represented by positive or negative columns, n-mantissa columns, and an additional column (n+1) – M. The necessity for introducing

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

second sign and additional columns will be shown later. 50X1

The first register (Rg1) is an output and stores the operation result R. The R number can be fed into the numerical main by special command. The result of a previous operation is simultaneously the initial number A for execution of the next operation. Before the completion of the first operation, the number A is received in the second register (Rg2) from the numerical main and then transcribed into the first register by special command. The second register serves as a receiver of the second number B of the operation from the numerical main. This number can be fed from the second register into the adder in a direct or additional code or in a direct code with a one column shift to the left.

The third register (Rg3) is a shifting element. It stores factors for multiplication operations and is the column recorder of quotients for division operations. The sign columns of this register are used for determining the sign of the product and of the quotient.

The adder consists of (n + 1) single-column adders at the three inputs. The commutation circuit enables the summation result to be recorded in the first register without shift, with a one-column shift to the left, or with a two-column shift to the right depending upon the algorithm of the operation being performed.

The arithmetic operations control block receives necessary information concerning their storage of numbers from all other blocks of the arithmetic unit. On the basis of this information, the arithmetic operations control block determines an algorithm for each step of an operation and issues corresponding control signals for carrying out each step of the operation. Also, cadence pulses are produced in the arithmetic operations control block which determine the beginning and end of the basic tempos for the operation of the whole machine.

Addition and subtraction operations are "short" and are performed at one basic tempo. Multiplication and division operations are "long" and are performed at one preparatory, several actuating, and one concluding tempos. The succession frequency of the actuating and concluding tempos is higher than the succession frequency of the basic tempo and is determined by a special circuit in the arithmetic operations control block. We will consider the operation of the arithmetic unit in performing arithmetic operations.

The addition operation. The algorithm for an addition operation is rather simple and can be examined by numerical examples. Two conditions can be met with in adding two numbers with a fixed point: the addition of numbers A and B which have identical signs and addition of the same two numbers with different signs.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

To derive a result in adding the numbers A and B which have identical signs, it is necessary to add the mantissas (modules) of the numbers, and confer the sign of either number, for example the sign of the first number, to the result. In this way, the algorithm for adding numbers of like signs appears as follows:

$$R = \text{zn. } A,\ (/A/ + /B/), \qquad (1)$$

where R is the result;
zn. A is the sign of number A and of result R;
/A/ and /B/ are the mantissas of the terms;
(/A/ + /B/) are the mantissas of result R.

When adding numbers with different signs, i. e., $(+A) + (-B)$, or $(-A) + (+B)$, the sign of the result will correspond to the sign of the larger number. In order to unify the operation of the machine, the sign of the first number is temporarily assigned to the result in these cases, and the modulus of the first number is added to the supplemented modulus of the second number, i. e., the operation $/A/ + /B/$ sup is carried out.

It is easy to see by numerical example that if the terms have different signs, two situations are possible: first, if $/A/ \geq /B/$, the sign of the result R must correspond to the sign of A. The mantissa of the sum $/A/ + /B/$ sup in the given case corresponds to the mantissa of the expected result, but this sum exceeds the correct result for a whole unit. Therefore, if $/A/ \geq /B/$, addition by machine means must be done by the algorithm:

$$R = \text{zn. } A,\ (/A/ + /B/ \text{ sup} - 1). \qquad (2)$$

Second, if $/A/ < /B/$, the sign of the result must be opposite that of the sign of A. But with this, the result of the addition $/A/ + /B/$ sup will be equal to the supplementary code from the necessary result R and there will be no unit of carry. To achieve a correct result in the given case, it is evident that it is sufficient to take the supplementary code from this sum with its sign, i. e., to use the algorithm:

$$R = [\text{zn. } A,\ (/A/ + /B/ \text{ sup})] \text{ sup}. \qquad (3)$$

Addition algorithms are realized in the arithmetic unit in the following manner. The first term A in the potential code is steadily fed to the adder input. The second term B is received from the numerical main in the second register. The arithmetic operations control block receives information about the term signs and gives out a control signal resulting from their comparison so that the number B is fed from the second register to the adder either in direct code (with like signs) or in a supplementary code (with unlike signs). The result of the summation is transcribed without shift from the adder output into the first register through the commutation circuit.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

During the summation, the arithmetic operations control unit receives information concerning the presence of a unit of carry from the mantissa columns to the sign columns. If the signs of the terms are identical (1), the presence of a unit of carry means that the result R is greater than 1, i. e., there was an overflow of the column frame and the computation could not be continued. If the signs of the terms are different (2), the presence of a unit of carry means that $/A/ > /B/$. In this case, the unit is not used and the correct result is written in the first register.

If there is no unit of carry with identical signs, this means that in the addition process according to the algorithm (1) the column frame is not exceeded and the correct result is written in the first register. If the terms have different signs and there is no unit of carry (3), this means that $/A/ < /B/$ and that the supplementary code of the result is recorded in the first register. Then according to the algorithm (3), the arithmetic operations control unit emits control signals by which the inversion (inverse code) contained in the first register is again fed to the adder where it is added with the "1" of the supplementary column which is supplied from the arithmetic operations control unit. Then, the necessary result R is received at the adder output and is transcribed into the first register as the final result of the operation.

The subtraction operation. This is the same as the addition operation, but with a simultaneous change of the operation sign and of the subtrahend, thus:

$$(\pm A) - (+B) = (\pm A) + (-B)$$

$$(\pm A) - (-B) = (\pm A) + (+B).$$

It is evident from these transformations that the subtraction of numbers with different signs is the same as the addition of numbers with like sign and consequently should be realized by the algorithm (1) and that subtraction of numbers with like signs is the same as addition of numbers with different signs and should be done by either algorithm (2) or (3). These algorithms are realized in the same way as in the addition operation.

The multiplication operation. The multiplication of binary numbers A and B, like the multiplication of decimal numbers, is the finding of partial derivatives of the multiplicand A on the next column of the factor B and the addition of each new partial derivative to the total of the previous ones. The order of each partial derivative depends on the order of the next factor column.

If there are many factor columns, such a summation is rather cumbersome and much time is required to complete the multiplication

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

[redacted]

50X1

operation which significantly increases the response time of the machine. If the repetition frequency of the actuating tempos is increased and the multiplication is performed not on one column of the factor, but on a double-column factor; the time required for the completion of the operation is significantly shortened. To do this, the factor B is broken down into $\frac{n+1}{2}$ double-column factors which are equal to 00, 01, 10, or 11.

If the factor B is represented as the sum of its digits with calculation of their order, it can be shown that the next partial total appears as follows:

$$R_4 = 2^{-2} [A \cdot b_n b_{n+1} + (Rg1)], \quad (4)$$

where
R_4 is the next partial total;
A is the multiplicand;
$b_n b_{n+1}$ is the next double-column factor;
(Rg1) is what is contained in the first register, i. e., the previous partial total.
When $b_n b_{n+1} = 00$, the formula (4) takes on the aspect;

$$R_{00} = 2^{-2} [0 + (Rg1)]. \quad (5)$$

This expression is an algorithm for multiplication by 00. It follows from this that to multiply by 00, it is sufficient to shift what is contained in the first register two columns to the right.

When $b_n b_{n+1} = 01$, from (4) we have:

$$R_{01} = 2^{-2} [A + (Rg1)]. \quad (6)$$

It follows from this that to multiply by 01, it is necessary to add the multiplicand to what is contained in the first register and to record the result of the multiplication again in the first register with a two column shift to the right.

When $b_n b_{n+1} = 10_{(2)} = 2_{(10)}$, from (4) we have:

$$R_{10} = 2^{-2} [2A + (Rg1)]. \quad (7)$$

Consequently, to multiply by 10, it is necessary to add the duplicate, i. e., shifted one column to the left, to what is contained in the first register and record the result and the multiplicand A in the first register with a two column shift to the right.

When $b_n b_{n+1} = 11_{(2)} = 3_{(10)}$, from (4) we have:

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

$$R_{11} = 2^{-2} [3A + (Rg1)] = 2^{-2} [4A - A + + (Rg1)] = A + 2^{-2} [-A + (Rg1)]. \quad (8)$$

To recycle A, i. e., to realize the first term of the expression (8), it is sufficient to add the unit to the next double-column factor. Subtraction of A from what is contained in the first register is substituted, as in the subtraction operation, by adding what is contained in the first register to the supplementary code A.

With calculation of this algorithm, multiplication by 11 takes on the aspect:

$$R_{11} = 2^{-2} [A_{sup} + (Rg1)] \quad (9)$$

With the storage of 1 to be added to the next factor. For realization of this algorithm, it is necessary to add what is contained in the first register to the supplementary code of the multiplicand and to record the result in the first register with a two-column shift to the right. Simultaneously, the value of the next double-column factor must be increased to unity.

The sign of the product is determined by logical addition, the result corresponding to the algebraic rule for determining the sign of a product:

$0+0 = 0$	$(+) \cdot (+) = (+)$
$0+1 = 1$	$(+) \cdot (-) = (-)$
$1+0 = 1$	$(-) \cdot (+) = (-)$
$1+1 = 0$	$(-) \cdot (-) = (+)$

The multiplication algorithm is realized in the following manner. In the preparatory cycle of the operation, the mantissa of the multiplicand A is transcribed from the first register to the second register. What is contained in the first register is discarded since in the first actuating cycle of the multiplication a "null" partial sum which is equal to zero should be recorded in the first register. The mantissa of the factor B is received from the numerical main in the mantissa columns in the third register. The sign of the number A from the sign columns of the first register and the sign of the number B from the sign columns of the numerical main alternately go along the computing input into the sign columns of the third register. The position of the flip-flop of these columns after reception of the sign of the second number characterizes the sign of the product in agreement with the rule which was presented earlier.

During each actuating cycle, what is contained in the first register is added to the next partial product which is determined by the formulas 5, 6, 7, or 9 depending upon the value of the next double-column factor.

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

The sum of the partial product, i. e., 0, A, 2A, or /A/$_{up}$, and what contained in the first register is the partial sum. This sum is again transcribed from the adder output into the first register through the commutation circuit with a two-column shift to the right which is equivalent to multiplying by 2^{-2}.

In each cycle, the value of the next factor is determined by the nth and (n+1) columns of the third register. To analyze the value of the next factor in each cycle, the mantissa columns of the third register are shifted two columns to the right.

After $\frac{n+1}{2}$ actuating cycles, the concluding operation cycle is accomplished. If multiplication by 11 is performed in the last actuating cycle, i. e., there is a unit of carry in the next factor, then it is necessary to multiply by 1 in the concluding cycle, or in other words, to add the multiplicand A to what is contained in the first register. This need not be done if there is no carry from the last factor. In both cases, it is necessary to round off the result in the concluding cycle. If a one is recorded in the discarded column (this is a supplementary column since it is absent in the numerical main), the result is rounded off by adding one to the newest (nth) column of the product.

To round off, what is contained in the first register is supplied to the adder where it is added to A; or, if carry is present from the last factor, it is added to the supplementary column unit of carry; or, if this carry is absent, it is added to the supplementary column unit of carry. If, in the given case, "1" was recorded in the supplementary column of the first register, then when it is added to the supplementary column unit of carry, the unit is recorded in the nth column of the first register. Thus, the mantissa of the rounded product is recorded in the first register. During this same cycle, the sign of the product is transcribed from the sign columns of the third register to the sign columns of the first register.

The division operation. The operation of dividing the binary number A by the binary number B, as in division with decimal numbers, has as its purpose the finding of a quotient R which must indicate how many times the dividend A is greater than the divisor B. Therefore, the operation consists of finding the remainders and numbers of quotients.

In division with decimal numbers, the product of the divisor and the next quotient number is subtracted from the remainder (from the dividend in the first step). In a binary system, the next number of the quotient can be only 0 or 1. Therefore, the division operation in this system is a comparison by means of subtraction of the dividend and of the divisor for the first step of the operation and to a comparison of the remainder (with calculation of its order) and the divisor in the other stages of

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

the operation. The order of the remainder is taken into account by shifting it one column to the left for each stage of the division. 50X1

Actually, the dividend A can always be represented in the following aspect:

$$A = BZ_0 + C_0 = BZ_0 + 2^{-1}(BZ_1 + C_1) =$$
$$= BZ_0 + 2^{-1}[BZ_1 + 2^{-1}(BZ_2 + C_2)] \ldots \text{etc.} \qquad (10)$$

where Z_i are the numbers of the conforming quotient column; C_i are the remainders.

From this, a connection between the remainders and the numbers of the quotient is evident:

$$C_0 = 2^{-1}(BZ_1 + C_1)$$
$$C_1 = 2^{-1}(BZ_2 + C_2)$$
$$\cdots\cdots\cdots\cdots\cdots\cdots$$
$$C_{n-1} = 2^{-1}(BZ_n + C_n) \qquad (11)$$

On the basis of the formula (11), the next remainder is expressed by the preceding:

$$C_n = 2C_{n-1} - BZ_n. \qquad (12)$$

To find the next remainder in each division stage, it is necessary to solve the equation (12) which contains two unknowns; Z_n and C_n. In this equation, Z_n can be only zero or one and the remainder must be a positive term.

With $Z_n = 1$, we have from (12):

$$C_n = 2C_{n-1} - B. \qquad (13)$$

This comparison of the double remainder and the divisor is carried out in each operation stage. Of course, the subtraction of B from $2C_{n-1}$ is replaced by adding the supplementary code of B to $2C_{n-1}$, i. e.,

$$C_n = 2C_{n-1} + B_{sup}. \qquad (14)$$

However equations 13 and 14 give a true remainder only when $Z_n = 1$.

If $Z_n = 0$, formula (13) produces an incorrect, negative remainder:

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

$$C_{n_{inc}} = 2C_{n-1} - B. \qquad (15)$$

50X1

With this, a true remainder is achieved by substituting the value $Z_n = 0$ in (12):

$$C_{n_{tr}} = 2C_{n-1}. \qquad (16)$$

But with the incorrect remainder $C_{n_{inc}}$, the next remainder in the next step of the division can be achieved on the bases of formulas 12, 16, and 15:

$$\begin{aligned} C_{n+1_{tr}} &= 2C_{n_{tr}} - B = 2C_{n_{tr}} - 2B + B = \\ &= 2\,(C_{n_{tr}} - B) + B = 2\,(2C_{n-1} - B) + B = \\ &= 2C_{n_{inc}} + B. \end{aligned} \qquad (17)$$

or correspondingly:

$$C_{n_{tr}} = 2C_{n-1_{inc}} + B. \qquad (18)$$

Thus the final division algorithm can be formulated as follows: after receiving a positive remainder C_{n-1tr} the next number of the quotient is 1 and the next division step must be the performance of $C = 2C_{n-1_{inc}} + B_{sup}$. After receiving a negative remainder $C_{n-1_{inc}}$, the next number of the quotient is 0 and the next division step must be the performance of $C_n = 2C_{n-1_{inc}} + B$; in the first step of the division, $C_0 = A - B = A + B_{sup}$ and Z_0 is the inversion of the remainder sign. The quotient sign is determined in the same way as in multiplying or adding.

The division algorithm is realized in the following manner. During the preparatory cycle, the mantissa of the divisor B is fed from the numerical main into the mantissa columns of the second register. The sign of the dividend A from the sign columns of the first register and the sign of the divisor B from the sign columns of the numerical main are alternately supplied to the sign columns of the third register to determine the sign of the quotient.

During each actuating cycle, what is contained in the first register (this is the dividend A in the first cycle and the double remainders in the other cycles) is supplied to the adder where it is added to the divisor which is supplied from the second register in a direct (according to 18) or in an inverse (according to 14) code. The achieved remainder

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4

50X1

C_n is transcribed from the adder output through the commutation circuit to the first register with a duplicate, i. e., with a one-column shift to the left.

The first sign column of the first register always characterizes the sign of the remainder C_n until its shift. What is contained in the third register is shifted one column to the left and the inverse of the first sign column of the first register is recorded in the supplementary column of the first register as the next number of the quotient. After the completion of $n+2$ actuating cycles, the quotient which consists of the number of the zero column, the numbers of the mantissa columns, and the $(n+1)$ number of the supplementary column is recorded in the third register.

During the concluding cycle, this quotient and sign are transcribed through the adder and the commutation circuit to the first register without shift. This is done through the adder so that the additional column or the quotient can be used for rounding off the result similar to the way in which it was done in the concluding cycle of the addition operation.

Other arithmetic units can do many logical operations and produce signals, but in view of their specialized purposes they were not considered in this article.

We Vary Forms of Technical Propaganda -- by Engr-Maj B. S. AVGUSTOVSKIY (Page 76)

Abstract:

Discusses means employed at the author's school for keeping personnel informed of technical and scientific developments.

FROM THE HISTORY OF PVO TROOPS

A Battery of Heroes -- by Lt Col (Res) M. F. ARTEMENKO (Pages 77-80)

Abstract:

Describes the formation and narrates the World War II combat deeds of the First Battery imeni Sevastopol Antiaircraft Artillery School (Pervaya Batareya imeni Sevastopol'skogo uchilishcha zenitnoy artillerii), which is today the Zhitomir Radiotechnical School (Zhitomirskoye Krasnoznamennoye radiotechnicheskoye uchilishche).

Declassified in Part - Sanitized Copy Approved for Release 2013/11/08 : CIA-RDP80T00246A071600020001-4